Publication No. 85-e17

JOHN SPELLMAN
Governor

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
7272 Cleanwater Lane, LU-11 • Olympia, Washington 98504-6811 • (206) 753-2353

MEMORANDUM
January 25, 1985

To: Jim Krull

From: Art Johnson and Dale Norton, Water Quality Investigations Section

Subject: Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek Drainage, August 1983 - September 1984.

ABSTRACT

Water, sediment, and fish tissue samples collected from Hylebos Creek between August 1983 and September 1984 were analyzed for arsenic and other metals, with the primary aim of identifying impacts due to two industrial landfills within the drainage. Arsenic concentrations in both water and sediment increased substantially below both landfills. Gill tissue from cutthroat trout collected in the creek had arsenic concentrations one to two orders of magnitude higher than fish tissue samples from other western Washington rivers. Noteworthy changes in concentrations of other metals in water, sediment, and tissue were not observed. A comparison of arsenic loads in discharges to Hylebos Waterway indicates Hylebos Creek, the Pennwalt process effluent, and runoff from log sort yards with ASARCO slag ballast are the major arsenic sources to these waters.

INTRODUCTION

The Water Quality Investigations Section (WQIS) had responsiblity for five projects† in the Commencement Bay Nearshore/Tideflats Remedial Investigation. Project 2, reported here, centered around concern for potentially

†WQIS projects:
- No. 1 - Assessment of Log Sort Yards as Metals Sources to Commencement Bay Waterways
- No. 2 - Metals in Hylebos Creek Drainage
- No. 3 - Point Source Monitoring
- No. 4 - Source Evaluation for Metals in Sitcum Waterway Sediments
- No. 5.1 - Priority Pollutants in City Waterway Storm Drains
- No. 5.2 - Metals in City Waterway Sediments
- No. 5.3 - Petroleum Compounds in D Street Groundwater and Adjacent City Waterway Sediment

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

elevated metals concentrations in Hylebos Creek due to two industrial landfills, U.S. Gypsum and B & L, in the upper drainage basin. Historical water quality data collected by EPA and WDOE at Hylebos Creek mouth suggested the creek may also be one of the more important sources of arsenic, zinc, and mercury to Hylebos Waterway.

To investigate these potential problems, the following work was done:

1. Low-flow survey, August 22-24, 1983. Metals concentrations and flow were measured in Hylebos Creek and tributaries. Conventional water quality parameters were measured in the mainstem of the creek.

2. Wet-weather survey, February 15, 1984. A second set of metals and limited conventionals data was gathered during a period of increased runoff.

3. Sediment collection, August 23, 1983, October 10, 1983, and February 14, 1984. Samples of stream bed material were collected from seven sites for metals analysis.

4. Fish collection, August 24, 1983. Cutthroat trout (Salmo clarki) were analyzed for metals, pesticides, and PCB. (This was done as an addition to WDOE's 1983 Basic Water Monitoring Program. The data for organics are reported elsewhere [WDOE, 1984].)

5. Routine monitoring August 1983 through September 1984. Data were collected at Hylebos Creek mouth once a month for metals, flow, and conventional parameters.

A sample of B & L landfill leachate was also collected on February 14, 1984, and analyzed for EPA organic priority pollutants/hazardous substances. These data are in Appendix I.

DRAINAGE BASIN DESCRIPTION

Hylebos Creek (Figure 1) headwaters are at Lake Killarney in King County. The creek drains twenty square miles, flowing in a generally southwest direction through agricultural land and residential areas to Hylebos Waterway on Commencement bay five miles distant. Elevation loss is 120 feet/mile from the headwaters to Milton, and 8.5 feet/mile from there to the mouth (Consoer, Townsend and Assoc., 1984).

Two and one-half miles below Lake Killarney, one of Hylebos Creek's three largest tributaries enters from the west. This unnamed creek drains land between Old Highway 99 and Interstate 5.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Immediately downstream of Interstate 5, Hylebos Creek flows along the southeast corner of a 2.6-acre landfill owned by U.S. Gypsum Company. This fill contains baghouse dust, paper, asphalt-coated paper, and off-spec mineral fiber deposited between 1971 and 1973. The baghouse dust is from the manufacture of mineral insulation made from ASARCO slag, and is reported to contain the amounts of metals shown in Table 1:

Table 1. Metals content of baghouse dust in the U.S. Gypsum landfill on Hylebos Creek.

arsenic	21.7%	zinc	2.83%
lead	6.35%	copper	1.03%
antimony	6.2%		

Source: U.S. Gypsum data as reported in Dames & Moore (1982).

Groundwater samples at the U.S. Gypsum site have contained up to 9,400 ug/L arsenic, 824 ug/L zinc, 510 ug/L copper, and 180 ug/L lead (Dames & Moore, 1983). (As of this writing, U.S. Gypsum has voluntarily removed the southern portion of the landfill which contains the baghouse dust, and shipped it to Arlington, Oregon, for disposal.)

Two discharges to Hylebos Creek from the U.S. Gypsum site were observed during the present surveys. One is a ditch running between Interstate 5 and the east fill boundary which collects runoff from both the highway and north half of the fill. The other discharge comes from a two-foot diameter corrugated steel pipe drain at the fill's southeast corner. This drain was dry during the low-flow survey, and is submerged during periods of high flow in the creek.

The second major tributary to Hylebos Creek is the Surprise Lake drainage which enters on the left bank 500 feet below the U.S. Gypsum fill. A second landfill, B & L, is located along Surprise Lake drain about 600 feet from its confluence with Hylebos Creek. This fill is thought to have been started in 1975 (Hedges, 1984) and is now 17.3 acres in size. It consists primarily of soil and wood waste scraped from the surface of log sort yards on the Tacoma tideflats. A number of these yards used ASARCO slag as ballast to stabilize the yard surface. A perimeter ditch collects drainage from the fill and discharges it to Surprise Lake drain. Analysis of a sample of the leachate in this ditch, collected by personnel from the WDOE Southwest Regional Office during a January 1982 inspection, showed the following concentrations of metals (Table 2):

Table 2. Metals concentrations in a sample of leachate from B & L landfill collected by WDOE January 19, 1982 (ug/L total metal).

Metal	Concentration
arsenic	10,000
lead	20u
zinc	390
copper	10u
nickel	20u

u = not detected at detection limit shown

The Fife drainage ditch system comprises the third large inflow to Hylebos Creek. It discharges at a tide gate just upstream of Marine View Drive bridge at the creek mouth. Ditch water is pumped over the gate at high tide.

Historical flow data for Hylebos Creek are limited to a crest-stage gauge in the upper basin discontinued in 1967 and a brief continuous record at a station 0.5 mile from the mouth for the years 1949 and 1950 (Consoer, Townsend, 1974). Flow data collected from the mouth of Hylebos Creek at Marine View Drive during the present WDOE survey were used to construct the hydrograph in Figure 2 below, which also shows timing of the two principal water quality surveys reported here. Flows in Hylebos Creek are tidally influenced for about one mile upstream of the mouth.

Memo to Jim Krull
Completion Report on WOIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

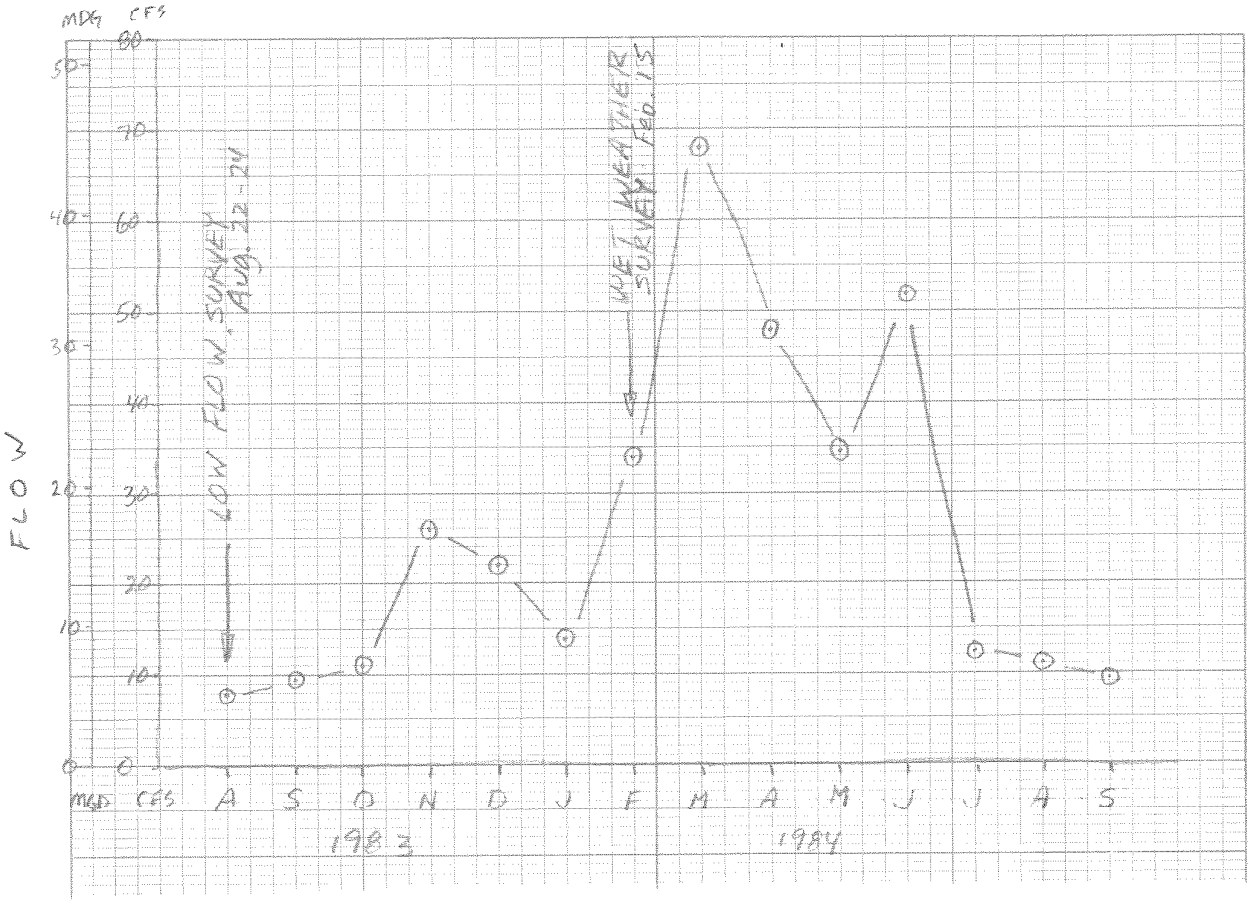

Figure 2. Monthly flow data for Hylebos Creek at mouth, August 1983 - September 1984 (WDOE Station 10GO60).

The Washington State Department of Fisheries lists coho and chum salmon as species utilizing Hylebos Creek drainage during the freshwater stages of their life cycles (WDF, 1975). Coho, chum, and chinook are planted in the creek in March and April by the Puyallup Indian Tribe. The release site is about one mile upstream of I-5 in the west tributary described above (Thayer, 1983). WDOE biologists have observed coho, chinook, cutthroat, steelhead, stickleback, and three species of sculpin in Hylebos Creek; starry flounder and staghorn sculpin have been noted in parts of the creek influenced by saltwater (Kittle, 1984).

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

METHODS

Station locations are in Figure 1.

Water - Water samples for metals were collected in new polyethylene cubitainers previously rinsed with deionized water. Samples were acidified to pH ≤ 2 with HNO_3 within twenty-four hours of collection. Metals were analyzed at the EPA/WDOE Manchester, Washington, laboratory by atomic absorption spectrometry employing a graphite furnace as described in EPA (1979) Methods for Chemical Analysis of Water and Wastes. Mercury was analyzed using the cold vapor method. Samples for determination of dissolved metals were filtered in the laboratory through 0.45 micron Millipore filters prior to being acidified.

Samples for conventional water quality parameters were collected in half-liter polyethylene bottles (specific conductivity, hardness, pH, turbidity, and total suspended solids), 250 mL polyethylene bottles containing 2 mLs concentrated H_2SO_4 (nutrients); and 250 mL sterilized glass bottles (fecal coliform bacteria). Dissolved oxygen was measured by the azide modification of the Winkler method. Temperature was determined with a precision thermometer. The WDOE Tumwater, Washington, laboratory did the conventional analyses according to methods described in EPA (1979).

Flows were gaged with a Marsh-McBirney magnetic flow meter, top-setting rod and measuring tape.

All samples were placed on ice immediately after collection. WDOE chain-of-custody procedures were followed.

Bioassay - To assess the potential for toxicity to juvenile salmon inhabiting Hylebos Creek and tributaries, a 96-hour bioassay using Coho salmon (Onchorhynchus kisutch) as the test organism was done on a sample of leachate from B & L landfill. Fifty gallons of leachate were collected in a plastic carboy on October 17, 1983, and returned to the WDOE Tumwater laboratory for testing. Methods were as described in WDOE (1981) General Procedure for Static Basic Acute Fish Toxicity Test. Details of the test done on the leachate are reported in Kjosness (1983).

Sediment - Sediment samples were collected by core and the top 2 cm layer removed for analysis. Several cores were composited from each station and homogenized by stirring. Subsamples of this homogenate were transferred to separate 4 1/2 ounce polyethylene cups for metals and percent moisture analyses, and one-pint glass jars for grain size, total organic carbon, and nitrogen analyses (February 14, 1984, samples only, see Appendix II).

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Metals analyses on sediment were done at the EPA/WDOE Manchester laboratory. Samples were digested with HNO_3/H_2O_2 following EPA (1982) Test Methods for Evaluation of Solid Wastes, then analyzed by atomic absorption spectrometry, except for mercury which was determined by the cold vapor method. All metals analyses were according to EPA (1979) Methods for Chemical Analysis of Water and Wastes. Percent moisture was measured at the WDOE Tumwater laboratory using EPA Method 160.3 (EPA, 1979).

Grain size, total organic carbon, and nitrogen analyses were done by Am Test, Inc. in Seattle, Washington. Analysis followed EPA/COE (1981) Procedures for Handling and Chemical Analysis of Sediment and Water Samples. Grain size was determined by the method of sieves and pipettes; total organic carbon and nitrogen were done on a Perkin-Elmer elemental analyzer.

Fish Tissue - Six cutthroat trout (Salmo clarki) were collected from Hylebos Creek near 67th Avenue East (Station 13 in Figure 1) on August 24, 1983, by WDOE personnel using a backpack electroshocker. The fish were wrapped in solvent-rinsed aluminum foil, packed in ice, and returned to the WDOE Tumwater laboratory for dissection. Muscle, gill, and viscera tissues were removed with acid- and solvent-rinsed, stainless steel instruments. Table 3 shows the samples obtained. As noted previously, the organics data are reported elsewhere (WDOE, 1984).

Table 3. Biological data and sample sizes for Hylebos Creek cutthroat trout (S. clarki) collected by WDOE August 24, 1983, for metals and organics analyses.

Number of Individuals	Fork Length (cm)	Total Weight (grams)	Tissue	Sample Weight (grams wet)	Sample Number	Analysis
1	32.4	371	gill	16.1	34562	metals
5	14.3-17.2	32-60	gill	47.9	34563	metals
			edible portion	153.1	34564	pesticides, PCBs
			viscera	42.6	34565	pesticides, PCBs

Tissue samples were analyzed at the EPA/WDOE Manchester laboratory. Metals samples were digested with a mixture of nitric acid and hydrogen peroxide. Analysis was by atomic absorption spectrometry using a graphite furnace as described in EPA (1979). Mercury was done by the cold vapor technique described in the same manual.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Quality Assurance - These surveys were done in accordance with a quality assurance program (WDOE, 1983) developed following requirements and guidelines set down in Final QA Program Plan for Commencement Bay Nearshore/Tideflats Remedial Investigation (Tetra Tech, 1983).

The EPA Manchester labaoratory achieved ± 3 percent accuracy on EPA performance evaluation metals samples (EMSL, Cincinnati, Ohio) run as internal standards and spike recoveries of 85 to 110 percent (Arp, 1984). Laboratory blanks analyzed separately from field samples as a check against metals contamination arising from sample containers, HNO_3 preservative, or analytical procedures consistently had metals concentrations at or below the limits of detection. Field blanks for some collections in Hylebos Creek, however, had elevated concentrations of one or more metals. Where blank concentrations were substantial (i.e., >20 percent) relative to concentrations measured in water samples, data for that survey are not reported.† All field blank data are in Appendix III.

Prior to analyzing Hylebos Creek sediment samples, the accuracy of the Manchester laboratory methods was assessed for selected metals by analysis of National Bureau of Standards (NBS) standard estuarine sediment, with the following results (Table 4):

Table 4. Results of analysis of NBS standard estuarine sediment #1646.

Metal	NBS Stated Value (mg/Kg)	EPA/WDOE Determined Value (mg/Kg)	EPA/WDOE Value as Percent of Stated Value
Zinc	138 ± 6	114	83
Copper	18 ± 3	20	110
Lead	28.2 ± 1.8	24.1	85
Arsenic	11.6 ± 1.3	11.7	101
Chromium	76 ± 3	50	66
Cadmium	0.36 ± 0.07	0.38	106
Mercury	0.063 ± 0.012	0.062	98
Antimony	0.4 (not certified)	<0.1	<25

†In the case of mercury, all data for the period January-July 1984 had to be discarded. This was later determined to be due to an unidentified source within the WDOE Tumwater laboratory (Stinson, 1984a). All water samples stored at the laboratory during this period showed evidence of contamination. As a result, Hylebos Creek samples collected July-September 1984 were handled only through the EPA/WDOE Manchester laboratory.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

The Manchester laboratory measurements coincide with the NBS-certified values for copper, arsenic, cadmium, and mercury, but were slightly lower for zinc and lead. Because of the substantial discrepancy between Manchester and NBS for chromium, a second sample of the standard was re-analyzed by the same method with a resulting improved chromium value of 61 ± 3 mg/Kg (mean ± 1 SD of six replicates). In the opinion of the analyst, accuracy of the Manchester chromium analysis for the data reported here probably lies somewhere between 66 percent to 80 percent of the actual values (Stinson, 1984b).

A duplicate prepared in the field from one of the sediment samples collected at Surprise Lake drain mouth was also analyzed by the Manchester laboratory, as shown below in Table 5. The average of duplicate results on this sample is used in the report.

Table 5. Results of duplicate sample analysis on sediment collected at Surprise Lake drain drain mouth February 14, 1984.

Metal	Sediment #140593 (mg/Kg)	Sediment #140593 (duplicate) (mg/Kg)	Relative Percent Difference
Arsenic	121	112	7.4
Antimony	0.1	0.1	0
Zinc	55.8	54.8	1.8
Copper	15.4	25.2	64
Lead	11.9	15.2	28
Nickel	28.6	28.4	0.70
Chromium	18.4	14.7	20
Cadmium	0.16	0.17	6.3
Mercury	0.037	0.081	120
Beryllium	0.17	0.12	29

The accuracy of the Manchester laboratory analysis of metals in fish tissues is indicated by the results in Table 6 from analysis of EPA quality assurance fish sample No. 1 (EMSL, Cincinnati, Ohio).

Table 6. Results of analysis of EPA fish sample No. 1.

Metal	EPA Stated Value and Range (mg/Kg)	EPA/WDOE Determined Value (mg/Kg)	EPA/WDOE Value as Percent of Stated Value
Cadmium	0.16 (MDL - 0.32	0.16	100
Lead	0.26 (MDL - 0.62)	0.245	94
Arsenic	2.43 (0.85-4.01)	2.31; 2.45	95; 101
Selenium	0.37 (MDL - 0.75	0.50	130
Chromium	0.58 (MDL - 1.34)	N/A	--
Copper	2.21 (0.93 - 3.49)	2.60	118
Nickel	0.54 (MDL - 1.10	0.40	74
Zinc	43.6 (35.5 - 51.7)	46.1	106

MDL = mean detection limit.
N/A = not analyzed.

Metals analysis on water, sediment, and tissue were done by Roy Arp (EPA) and Margaret Stinson (WDOE).

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

RESULTS

Low-Flow Survey - Table 7 summarizes the metals and discharge data collected during low flow.

Table 7. Metals concentrations in Hylebos Creek and tributaries during WDOE low-flow survey, August 22-24, 1983 (ug/L total metal).

Station Number and Name	River Mile	Flow (MGD)	Arsenic	Antimony	Zinc	Copper	Lead	Cadmium	Mercury
1 Upper HYLEBOS CREEK at 5th Avenue	2.3	$0.51(0.50\text{-}0.52)_3$	$1u_5$	$2(1u\text{-}5)_5$	$4(1u\text{-}15)_5$	$19(8\text{-}36)_5$	$9(3\text{-}28)_5$	$0.1(0.1\text{-}0.2)_5$	$0.06u_5$
2 West Tributary* (at Birch Street)	2.15	$3.4(3.2\text{-}3.7)_2$	1u	1	6	8	10	0.1	0.06u
3 Milton ditch	2.05	No flow	--	--	--	--	--	--	--
4 HYLEBOS CREEK above U.S. Gypsum	1.9	Not gaged	$3(1\text{-}3)_3$	N/A	N/A	N/A	N/A	N/A	N/A
5 U.S. Gypsum ditch†	1.9	0.01 (est)	129	11	12	13	14	1.3	0.06u
8 HYLEBOS CREEK below U.S. Gypsum	1.5	4.1	$3(2\text{-}5)_3$	N/A	N/A	N/A	N/A	N/A	N/A
12 Surprise Lk. drain*	1.5	$0.17(0.13\text{-}0.21)_3$	158	2	13	30	13	0.1	0.06u
13 HYLEBOS CREEK at 67th Avenue East	1.4	Not sampled	--	--	--	--	--	--	--
14 HYLEBOS CREEK at at 8th Avenue East	1.2	$4.2(4.1\text{-}4.4)_3$	$1u_5$	$1(1u\text{-}2)_5$	$7(3\text{-}17)_5$	$13(5\text{-}18)_5$	$9(8\text{-}12)_5$	$0.1(0.1u\text{-}0.5)_5$	$0.06u(0.06u\text{-}0.07)_5$
15 Fife ditch*	0.1	$0.14(0.084\text{-}0.18)_3$	1u	1u	18	36	14	0.1	0.06u
16 Marine View Drive* drainage	0.1	$0.016(0.013\text{-}0.019)_3$	1u	1	14	8	19	0.1u	0.06u
17 HYLEBOS CREEK mouth at Marine View Dr. bridge	0.0	$5.0(4.9\text{-}5.1)_3$	$1u(1u\text{-}2)_5$	$1u(1u\text{-}6)_5$	$10(5\text{-}38)_5$	$12(10\text{-}23)_5$	$11(8\text{-}11)_5$	$0.1(0.1u\text{-}0.3)_5$	$0.06u_5$
18 Hylebos Waterway off Hylebos Creek mouth	--	--	$1u_3$	$1u(1u\text{-}3)_3$	$19(6\text{-}15)_3$	$17(9\text{-}29)_3$	$2(2\text{-}3)_3$	$0.1(0.1\text{-}0.3)_3$	$0.06u_3$
field blanks (330083-85)	--	--	$1u_3$	$1u_3$	$1u_3$	$1u(1u\text{-}6)_3$	$1u_3$	$0.1u_3$	$0.06u_3$
EPA Criteria F.W. Aquatic Life (100 mg/L hardness) Fed. Reg. Vol. 45, No. 231, 1980.									
"Not to exceed at any time"			440	--	320	22	170	3.0	4.1
"24-hour average"			140** 72	1600	47	5.6	3.8	0.025	0.2

MEDIAN(RANGE)$_{\text{NUMBER OF SAMPLES}}$
u = not detected at detection limit shown
N/A = not analyzed
*composite of five grabs
†single grab
**dissolved

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

There had been no measurable rainfall for nineteen days prior to sampling.* Dry conditions continued throughout the three-day survey, as demonstrated by the gaging data which show stable creek flows. Upper Hylebos Creek was gaged each day with resulting measurements of 0.52, 0.51, and 0.50 MGD. Flow in the west tributary to the creek was between 3.2 and 3.7 MGD, or about seven times greater than the upper creek. Discharges coming into Hylebos Creek at points below the west tributary confluence were low in volume, 0.21 MGD or less. The creek's final discharge to Hylebos Waterway was 4.9 to 5.1 MGD.

Metals concentrations in Hylebos Creek were low and did not change substantially with distance downstream. Arsenic, antimony, cadmium, and mercury were near or below detection limits in all creek samples. Median zinc, copper, and lead concentrations were in the range of 4 to 19 ug/L. Concentrations were within EPA criteria for protecting aquatic life, shown at the bottom of Table 7, except for the EPA's low chronic exposure criteria for copper (5.6 ug/L), lead (3.6 ug/L), and cadmium (0.025 ug/L).

Tributaries and other discharges to Hylebos Creek also had a low metals content with the exception of arsenic (129 ug/L) and cadmium (1.3 ug/L) in U.S. Gypsum ditch and arsenic (158 ug/L) in Surprise Lake drain. The corrugated pipe drain at U.S. Gypsum was dry, as noted earlier. The loads of arsenic and cadmium from U.S. Gypsum ditch were calculated to be 0.01 and 0.0001 pound/day, respectively, insufficient to influence downstream concentrations in Hylebos Creek. Surprise Lake drain constituted a much higher arsenic load of 0.23 pound/day which, taking the upstream concentration as 3 ug/L (Station 8) and assuming conservative mixing, would be sufficient to cause arsenic concentrations in Hylebos Creek to increase by 6 ug/L. An increase in arsenic concentrations, however, was not observed; all samples downstream of this discharge were below detection limits. Data discussed later show 68 percent of the arsenic in this sample was in particulate form which may have settled out under the low-velocity conditions that existed in this part of the creek (0.6 ft/sec average at station 8 immediately above Surprise Lake confluence).

The data in Table 8 from a series of samples collected August 22 indicate that the source of elevated arsenic in Surprise Lake drain was B & L landfill. An arsenic concentration of 26,900 ug/L was measured in the leachate as it emerged from the fill. There was 5,400 ug/L of arsenic at the point B & L ditch discharged to Surprise Lake drain. Concentrations of arsenic increased from below detection limits (1 ug/L) above B & L to 110 ug/L at the drain's confluence with Hylebos Creek. Based on the flows obtained, an arsenic concentration of 240 ug/L would have been predicted at Surprise Lake drain mouth after mixing with the B & L discharge. (The arsenic concentration of 158 ug/L, noted above, was measured in a composite

*Rainfall data provided by Raymond Redding, Tacoma Central STP.

sample from the drain mouth spanning the three-day survey.) Antimony, zinc, copper, lead, and cadmium were also elevated in B & L leachate and were about an order of magnitude over background concentrations in Surprise Lake drain. Leachate flow was too low to affect downstream concentrations of these metals in Surprise Lake drain or Hylebos Creek.

Table 8. Metals concentrations in samples from Surprise Lake drainage to Hylebos Creek collected by WDOE August 22, 1983 (ug/L total metal).

Station Number and Name	Flow (MGD)	Arsenic	Antimony	Zinc	Copper	Lead	Cadmium	Mercury
9 Surprise Lake drain above B & L landfill	0.16	1u	1u	24	27	16	0.1	0.06u
10 B & L leachate	0.0016	26,900	53	673	93	115	0.8	0.06u
11 B & L ditch at Surprise Lake drain	--	5,400	4	131	14	20	0.1	0.06u
12 Surprise Lake drain at Hylebos Creek	0.18	110	2	1u	23	11	0.1	0.06u

Arsenic concentrations in Surprise Lake drain within the B & L leachate plume would exceed EPA criteria until the leachate were completely mixed. The EPA criteria statement for arsenic includes the comment that "short-term effects on embryos and larvae of aquatic vertebrate species have been shown to occur at 40 ug/L." This concentration would have been exceeded between B & L ditch mouth and the mouth of Surprise Lake drain.

A sample of B & L leachate was also analyzed for a series of conventional water quality parameters. These results, in Table 9, show the leachate to be high in turbidity, color, solids, ammonia, and phosphorus. The COD data indicate the leachate may reduce oxygen concentrations in the receiving waters. Tannic acid is toxic to juvenile salmon at concentrations of 2 mg/L (Holland, 1960). The tannin and lignin analysis done in the leachate is not specific for tannic acid, but the high concentration measured, 56 mg/L, suggests a potential for toxicity.

Table 9. Water quality of leachate sample from B & L landfill collected by WDOE August 22, 1983.

Parameter	Concentration
Specific conductivity (umhos/cm)	1,340
pH (units)	6.2
Turbidity (NTU)	920
Color (units)	680
Tannin & lignin (mg/L as tannin)	52
Chemical oxygen demand (mg/L)	670
Fecal coliform (col/100 mL)	67 est.
Total suspended solids (mg/L)	490
NH_3-N (mg/L)	2.1
NO_2-N (mg/L)	<0.05
NO_3-N (mg/L)	<0.05
T-PO_4-P (mg/L)	0.40

Because some of these data suggested possible adverse effects on salmonids and other organisms, particularly in portions of the drainage influenced by B & L landfill, a bioassay using juvenile coho salmon (Onchorhynchus kisutch) was done of B & L leachate. The results, along with conventionals and metals analysis done on undiluted leachate, are in Table 10. All fish died when exposed to undiluted leachate. The data recorded during the bioassay indicate these deaths occurred within the first 24 hours (Kjosness, 1983). A 50 percent solution of leachate caused 43 percent mortality. Further dilution to 10 percent resulted in an essentially non-toxic response (1 of 30 fish died) for a 96-hour exposure. No long-term tests were done.

Although the agent(s) responsible for the mortalities observed in this test cannot be conclusively identified, the arsenic concentration in the 50 percent exposure, where 43 percent of the fish died, would have been approximately 11,200 ug/L. This compares favorably with the LC_{50} of 11,000 ug/L determined by Alderdice and Brett (1957) for chum salmon fry in a 48-hour exposure to arsenic trioxide. Holland, et al. (1960) reported an LC_{100} (96-hour exposure) of 12,307 ug/L (arsenic trioxide) for pink salmon. The chemical form of arsenic in the WDOE bioassay is not known.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Table 10. **Results of 96-hour coho salmon (Onchorhynchus kisutch) bioassay on a leachate sample from B & L landfill collected by WDOE October 17, 1983.**

Initial Water Quality of Leachate

dissolved oxygen (mg/L)	5.4	Rec. phenolics (mg/L as phenol)	3.1	T-PO4-P (mg/L)	6.0	copper (ug/L)	48
pH (S.U.)	6.6	Tannin & lignin (mg/L as tannin)	56	O-PO4-P "	2.2	lead "	71
Total Hardness (mg/L as CaCO3)	616	NH3-N (mg/L)	4.6	arsenic (ug/L)	22,400	chromium "	1u
Alkalinity (mg/L as CaCO3)	576	NO2-N "	<0.10	antimony "	15	cadmium "	0.4
Specific Cond. (umhos/cm)	1340	NO3-N "	<0.10	zinc "	354	mercury "	0.06

Bioassay Results

Leachate Concentration	Mortality
100%	30/30 = 100%
50%	13/30 = 43%
10%	1/30 = 3%
1%	0/30 = 0%
control	0/30 = 0%

Conventional water quality analysis on samples from upper, middle, and lower Hylebos Creek, Table 11, show the creek met Washington State Class A standards for temperature, pH, and dissolved oxygen under the low-flow conditions surveyed. Turbidity and suspended solids increased substantially in the lower reaches of the creek. High specific conductivity at the creek mouth is due to saltwater influence. There was evidence of substantial water quality degradation due to bacteria. Fecal coliform levels were high throughout the creek, reaching densities as high as 2,200 colonies/ 100 mL at the mouth. A second water quality problem is evident in the nutrient data which show ammonia and phosphorus concentrations had increased by a factor of ten by the time the creek reached Hylebos Waterway.

Table 11. Water quality in Hylebos Creek during WDOE low-flow survey, August 22-24, 1983.

Station Number and Name	River Mile	Flow (MGD)	Temperature (°C)	Specific Conductivity (umhos/cm)	Total Hardness as $CaCO_3$ (mg/L)	pH (S.U.)	Dissolved Oxygen (mg/L)
1 Upper Hylebos Creek at 5th Avenue	2.3	0.51(0.50-0.52)*	12.2(11.5-12.3)	173(159-194)	81(73-81)	7.6(7.5-7.7)	10.3(10.1-10.4)
14 Hylebos Creek at 8th Avenue East	1.2	4.2(4.1-4.4)	13.1(13.0-13.4)	192(177-214)	85(81-85)	7.6(7.5-7.8)	9.2(9.0-9.6)
17 Hylebos Creek mouth at Marine View Dr. bridge	0.0	5.0(4.9-5.1)	14.3(14.1-14.8)	1540(1470-1560)	210(173-210)	7.5(7.4-7.5)	9.7(9.0-9.7)

Station Number and Name	River Mile	Turbidity (NTU)	Total Suspended Solids (mg/L)	Fecal Coliform (#/100 mL)	NH_3-N (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	T-PO_4-P (mg/L)	O-PO_4-P (mg/L)
1 Upper Hylebos Creek at 5th Avenue	2.3	2(2-3)	2(1-7)	620(430-1100)	.02(.02-.03)	.02(.01-.02)	1.1(1.0-1.1)	.04(.03-.04)	.03(.03-.04)
14 Hylebos Creek at 8th Avenue East	1.2	9(9-10)	12(10-19)	540(430-770)	.07(.07-.08)	.01(.01-.02)	.69(.65-.70)	.10(.08-.11)	.11 (all sam.)
17 Hylebos Creek mouth at Marine View Dr. bridge	0.0	13(12-15)	22(22-25)	1500(370-2200)	.24(.20-.25)	.02(all sam.)	.62(.61-.62)	.17(.16-.19)	.17(.17-.18)

*median(range) of three measurements/samples

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Wet-Weather Survey - The wet-weather data are summarized in Table 12. Creek flow was approximately five times greater than during the low-flow survey. Metals concentrations continued to be low except for arsenic which increased in all parts of the drainage except U.S. Gypsum ditch. Arsenic concentrations in the creek were within the EPA acute and chronic criteria, but in the middle reaches of the creek exceeded the 40 ug/L concentration noted in the criteria as adversely affecting vertebrate embryos and larvae. Concentrations of the other metals reported, antimony, zinc, nickel, chromium, and cadmium, were within EPA criteria except for the 0.025 ug/L chronic exposure criteria for cadmium. Although elevated metals concentrations in field blanks rendered the copper and lead data unusable, sample concentrations were not substantially different than those observed during low flow.

Table 12. Metals concentrations in Hylebos Creek and tributaries during WDOE wet-weather survey, February 15, 1984 (ug/L total metal).

Station Number and Name	River Mile	Flow (MGD)	Arsenic	Antimony	Zinc	Nickel	Chromium	Cadmium
1 Upper HYLEBOS CREEK at 5th Avenue	2.3	2.8	29(17-75)$_3$	1u$_3$	11(5-21)$_3$	2(1u-5)$_3$	3(1u-4)$_3$	0.1(0.1u-0.1)$_3$
2 West Tributary (at Birch Street)	2.15	7.1	5(5-9)$_3$	1u$_3$	11(10-15)$_3$	2(1-10)$_3$	1u(1u-3)$_3$	0.1u(0.1u-0.1)$_3$
3 Milton ditch*	2.05	0.11	14	1u	28	7	2	0.1
4 HYLEBOS CREEK above U.S. Gypsum	1.9	Not gaged	6(2-7)$_3$	1(1-2)$_3$	8(6-9)$_3$	6(1u-6)$_3$	3(1u-6)$_3$	0.1u(0.1u-0.1)$_3$
5 U.S. Gypsum ditch	1.9	0.078	83(64-109)$_3$	5(5-6)$_3$	7(5-9)$_3$	1u(1u-5)$_3$	1u(1u-1)$_3$	0.1(0.1u-1.0)$_3$
8 HYLEBOS CREEK below U.S. Gypsum	1.5	Not gaged	14(14 34)$_3$	1(1u-1)$_3$	12(4-32)$_3$	3(1-7)$_3$	2(1u-6)$_3$	0.1u(0.1u 0.1)$_3$
12 Surprise Lk. drain	1.5	2.9	209(186-209)$_3$	1(1u-1)$_3$	10(8-18)$_3$	1(1u-9)$_3$	1u$_3$	0.1u$_3$
13 HYLEBOS CREEK at 67th Avenue East	1.4	17.0	45(31-55)$_3$	2(1-4)$_3$	11(8-38)$_3$	1u(1u-13)$_3$	5(1-5)$_3$	0.1u$_3$
14 HYLEBOS CREEK at at 8th Avenue East	1.2	15.5	47(42-52)$_3$	1(1u-2)$_3$	11(10-44)$_3$	1u$_3$	4(3-8)$_3$	0.1u(0.1u-0.3)$_3$
15 Fife ditch*	0.1	10.0	25	3	54	10	1u	0.3
16 Marine View Drive* drainage	0.1	0.21	6	2	220	4	7	1.0
17 HYLEBOS CREEK mouth at Marine View Dr. bridge	0.0	26.5	36(35-42)$_3$	2(1u 3)$_3$	26(19 195)$_3$	1u(1u 1)$_3$	1u(1u 5)$_3$	0.1(0.1u 0.1)$_3$
18 Hylebos Waterway off Hylebos Creek mouth	--	--	27(26-33)$_3$	4(3-5)$_3$	35(27-38)$_3$	1u$_3$	8(4-11)$_3$	0.2(0.1-0.3)$_3$
field blank (140686)			1u	1u	3	1u	1u	1u
field blank (140687)			1u	1u	1u	1u	1u	1u
EPA Criteria F.W. Aquatic Life (100 mg/L hardness) Fed. Reg. Vol. 45, No. 231, 1980.								
"Not to exceed at any time"			440 140**	--	320	1800	4700	3.0
"24-hour average"			72	1600	47	96	44	0.025

MEDIAN(RANGE)$_{\text{NUMBER OF SAMPLES}}$
u = not detected at detection limit shown
*composite of three grabs
**dissolved

Whereas arsenic concentrations in upper Hylebos Creek had been below detection limits in all samples collected during low flow, a median concentration of 29 ug/L was measured during the wet survey which suggests a source of this metal in the upper drainage. Inspectors at the WDOE Southwest Regional Office are aware of one potential arsenic source here, a small woodwaste fill near the intersection of Porter Way and 7th Avenue (Pierce, 1985; Cloud, 1985). Due largely to dilution by the west tributary, the creek's arsenic concentration fell to a median of 6 ug/L (range 2 - 7 ug/L) before reaching U.S. Gypsum landfill. After passing the landfill the median arsenic concentration increased to 14 ug/L (range 14 - 34 ug/L). A second and larger increase in concentration followed below Surprise Lake drain where median concentrations in the creek peaked at 45 to 47 ug/L (range 31 - 55 ug/L). Concentrations of other metals did not change substantially with distance downstream, except for zinc which increased at the mouth of Hylebos Creek.

Table 13 has results from the wet-weather samples collected in Surprise Lake drainage. The metals concentrations in B & L leachate were more dilute than observed under low-flow conditions. Arsenic concentrations, however, remained sufficiently high, 5,370 to 8,400 ug/L, to cause an almost ten-fold increase in arsenic concentration in Surprise Lake drain. The leachate did not influence concentrations of other metals. The fact that 22 ug/L arsenic was measured upstream of Surprise Lake drain's confluence with B & L ditch suggests landfill runoff or leachate may have been getting into the drainage by an additional route.

Table 13. Metals concentrations in samples from Surprise Lake drainage to Hylebos Creek collected by WDOE February 15, 1984 (ug/L total metal).

	Station Number and Name	Flow (MGD)	Arsenic	Antimony	Zinc	Nickel	Chromium	Cadmium
9	Surprise Lake drain* above B & L landfill	2.6	22	1	7	1u	1	0.1u
10	B & L leachate	0.071	7850(5370-8400)$_3$	7(5-8)$_3$	119(117-143)$_3$	42(41-46)$_3$	3(2-4)$_3$	0.1u(0.1u-0.1)$_3$
11	B & L ditch at Surprise Lake drain	0.17	4940(4560-5400)$_3$	4(1-6)$_3$	75(73-77)$_3$	28(23-30)$_3$	1u(1u-5)$_3$	0.1(0.1-0.3)$_3$
12	Surprise Lake drain at Hylebos Creek	2.9	209(186-209)$_3$	1(1u-1)$_3$	10(8-18)$_3$	1(1u-9)$_3$	1u$_3$	0.1u$_3$

MEDIAN(RANGE)$_{\text{NUMBER OF SAMPLES}}$
*composite of three samples

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

The calculations in Table 14 show the extent to which arsenic loads measured in discharges to Hylebos Creek during the wet-weather survey accounted for the changes in concentration observed in the creek. The table summarizes the arsenic load for each discharge and then contrasts the change in concentration observed at the nearest station downstream of the discharge with the change expected as a result of the discharge†.

Table 14. Arsenic loads measured during the WDOE wet-weather survey in Hylebos Creek February 15, 1984, and relation to in-stream concentrations.

	Arsenic in Discharge			Arsenic Concentration* in Hylebos Creek (ug/L)			
				Above Discharge	Below Discharge		
Station Number and Name	Flow (MGD)	Concentration (ug/L)	Load (lbs/day)		Observed	Predicted	Difference
1. Upper HYLEBOS CREEK	2.8	29*	0.68				
2. West Tributary	7.1	5*	0.30	29	6	11	-5 (80% obs.)
3. Milton ditch	0.11	14	0.013	(no station)			
5. U.S. Gypsum ditch	0.078	83*	0.054	6	14	7	+7 (50% ")
12. Surprise Lake drain	2.9	209*	5.1	14	45	50	-5 (11% ")
15. Fife ditch	10.0	25	2.1	47	36	38	-2 (6% ")
16. Marine View Drive drainage	0.21	6	0.010				
17. HYLEBOS CREEK Mouth	26.5	36*	8.0				

*median

†Calculated with the formula $C = (C_H Q_H + C_D Q_D) \div (Q_H + Q_D)$, where $C_H Q_H$ are arsenic concentration and flow in Hylebos Creek above the discharge and $C_D Q_D$ are the data for the discharge in question.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

The major arsenic loads to Hylebos Creek were from Surprise Lake drain, 5.1 pounds/day and Fife ditch, 2.1 pounds/day. The load from U.S. Gypsum ditch was 0.054 pound/day. The arsenic load in Hylebos Creek increased from 0.68 pound/day in the upper creek to 8.0 pounds/day at the mouth. Predicted and observed changes in arsenic concentrations in Hylebos Creek are in good agreement for the Surprise Lake and Fife ditch/Marine View discharges. Arsenic concentrations below the west tributary confluence were lower than expected, probably due to dilution -- 0.4 river mile separates the two Hylebos Creek stations in question. The U.S. Gypsum ditch discharge had the potential to raise arsenic concentrations in Hylebos Creek by only 1 ug/L, in contrast to the 8 ug/L increase observed. Three sources of arsenic from U.S. Gypsum which may have been contributing arsenic to the system, but could not be measured, were diffuse runoff over the surface of the fill, groundwater discharge, and the corrugated pipe drain at the fill's southwest corner, previously mentioned as being underwater at high flows. The results of analysis of a sample collected in the spring of 1984, shown in Table 15, show a very high arsenic concentration in this discharge. Flow was estimated to be 0.01 MGD.

Table 15. Metals concentrations in a WDOE sample of discharge to Hylebos Creek from corrugated pipe drain at southwest corner of U.S. Gypsum landfill, collected May 9, 1984 (ug/L total metal).

Metal	Concentration	Metal	Concentration	Metal	Concentration
Arsenic	153,000	Copper	37	Chromium	9
Antimony	442	Lead	14	Cadmium	0.1u
Zinc	42	Nickel	1u	Mercury	0.051

The conventional water quality data from the wet-weather survey are in Table 16.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Table 16. Water quality in Hylebos Creek and tributaries during WDOE wet-weather survey, February 15, 1984.

Station Number and Name	River Mile	Flow (MGD)	Specific Conductivity (umhos/cm)	Total Hardness as $CaCO_3$ (mg/L)	pH (S.U.)	Total Suspended Solids (mg/L)
1 Upper HYLEBOS CREEK at 5th Avenue	2.3	2.8	$114(114\text{-}116)_3$	48_3	7.2_3	$4(4\text{-}6)_3$
2 West Tributary* (at Birch Street)	2.15	7.1	$153(152\text{-}157)_3$	$72(68\text{-}72)_3$	$7.4(7.2\text{-}7.5)_3$	$8(8\text{-}10)_3$
3 Milton ditch*	2.05	0.11	204	92	6.8	10
4 HYLEBOS CREEK above U.S. Gypsum	1.9	Not gaged	$144(144\text{-}147)_3$	$64(60\text{-}64)_3$	$7.2(7.1\text{-}7.2)_3$	$8(7\text{-}10)_3$
5 U.S. Gypsum ditch	1.9	0.078	$268(266\text{-}268)_3$	$120(110\text{-}120)_3$	7.3_3	$3(2\text{-}3)_3$
8 HYLEBOS CREEK below U.S. Gypsum	1.5	Not gaged	$148(148\text{-}149)_3$	$68(68\text{-}76)_3$	$7.2(7.1\text{-}7.3)_3$	$9(8\text{-}9)_3$
12 Surprise Lk. drain	1.5	2.9	253_3	100_3	$7.0(6.9\text{-}7.0)_3$	$16(16\text{-}18)_3$
13 HYLEBOS CREEK at 6/th Avenue East	1.4	15.5	171_3	$80(72\text{-}88)_3$	7.1_3	$9(7\text{-}11)_3$
14 HYLEBOS CREEK at at 8th Avenue East	1.2	17.0	$175(171\text{-}176)_3$	$76(72\text{-}76)_3$	7.2_3	$13(10\text{-}14)_3$
15 Fife ditch*	0.1	9.3	713	170	7.2	10
16 Marine View Drive* drainage	0.1	0.21	218	80	7.3	27
17 HYLEBOS CREEK mouth at Marine View Dr. bridge	0.0	26.5	$520(507\text{-}534)_3$	$120(110\text{-}120)_3$	$7.2(7.1\text{-}7.2)_3$	$18(16\text{-}22)_3$
18 Hylebos Waterway off Hylebos Creek mouth	--	--			$7.1(7.0\text{-}7.2)_3$	$15(15\text{-}17)_3$

MEDIAN(RANGE)$_{\text{NUMBER OF SAMPLES}}$
*composite of three grabs
N/A = not analyzed

Dissolved Arsenic Concentrations - Concentrations of dissolved arsenic were determined in B & L leachate and in water samples from points downstream of the landfill during both surveys. These data, in Table 17, show a consistent dissolved arsenic fraction of 16 to 19 percent in the leachate, and 26 to 38 percent in water from the mouth of Surprise Lake drain. The wet-weather data suggest a gradual increase in the percentage of arsenic in the dissolved form, reaching about 75 percent mid-way down Hylebos Creek at 8th Avenue and, thereafter, declining to less than 3 percent in Hylebos Waterway at the creek mouth. Results of arsenic analysis on seven additional filtered samples collected during routine monitoring at Hylebos creek mouth, discussed later, show a median of 14 percent dissolved arsenic here.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Table 17. Total vs. dissolved arsenic concentrations in Hylebos Creek drainage from B & L landfill to Hylebos Creek mouth, August 24, 1983, and February 15, 1984.

Station Number and Name		Total Arsenic (ug/L)	Dissolved Arsenic* (ug/L)	Percent Dissolved
		Low-flow survey, August 24, 1983		
10	B & L leachate	25,900	4,900	19%
12	Surprise Lake drain	140	46	32%
14	HYLEBOS CREEK at 8th Avenue East	1u	1u	--
17	HYLEBOS CREEK mouth at Marine View Drive bridge	2	1u	--
18	Hylebos Waterway off Hylebos Creek mouth	1u	1u	--
		Wet-weather survey, February 15, 1984		
10	B & L leachate	7,850	1,380	18%
	" "	8,400	1,380	16%
12	Surprise Lake drain	186	71	38%
	" " "	209	55	26%
14	HYLEBOS CREEK at 8th Avenue East	47	32	68%
		52	41	79%
17	HYLEBOS CREEK mouth at Marine View Drive bridge	36	4	11%
		35	20	57%
18	Hylebos Waterway off Hylebos Creek mouth	33	1u	<3%
	filtrate blank (140686)	1u	1u	--

*0.45 micron filter
u = not detected at detection limit shown

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Sediment - The results of metals analyses of sediments in the Hylebos Creek drainage are in Table 18. Large increases in arsenic content were observed in creek sediments below both landfills. The three samples collected above U.S. Gypsum landfill had arsenic concentrations of 3.0, 3.2, and 5.1 mg/Kg (dry weight) compared to 24, 44, and 45 mg/Kg in samples below the landfill. In Surprise Lake drainage, arsenic concentrations above and below the landfill were 10, 12, and 13 mg/Kg versus 100, 120, and 150 mg/Kg.

Table 18. Metals concentrations in sediment samples collected by WDOE in Hylebos Creek drainage August 1983-February 1984 (mg/Kg, dry weight).

Station Number and Name	River Mile	Sampling Date	Arsenic	Antimony	Zinc	Copper	Lead	Nickel	Chromium	Cadmium	Mercury	Beryllium
1 Upper HYLEBOS CREEK at 5th Avenue	2.3	08/23/83	21	0.4	42	11	6	25	17	0.11	0.005	N/A
		10/21/83	2.0	0.1u	36	5.9	4.1	27	24	0.06	N/A	N/A
		02/14/84	1.3	0.1	36	11	6.0	36	19	0.32	0.009	0.17
		10/22/84	1.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4 HYLEBOS CREEK above U.S. Gypsum	1.95	08/23/83	3.0	0.1u	48	9.0	8	25	16	0.15	0.003u	N/A
		10/21/83	3.2	0.1u	44	6.1	11	27	29	0.07	N/A	N/A
		02/14/84	5.1	0.1u	49	12	6.9	39	23	0.07	0.007	0.31
7 HYLEBOS CREEK below U.S. Gypsum	1.7	08/23/83	24	0.1u	43	8.2	5	22	13	0.12	0.003	N/A
		10/21/83	44	0.1u	42	5.5	4.9	23	22	0.07	N/A	N/A
		02/14/84	45	0.1u	49	15	8.5	39	23	0.13	0.009	0.20
9 Surprise Lake drain above B & L Landfill	--	10/21/83	13	0.1u	42	8.9	6.4	17	17	0.11	N/A	N/A
		10/21/83	12	0.1u	66	14	14	17	26	0.21	N/A	N/A
		02/14/84	10	0.1u	43	18	9.1	25	14	0.12	0.11	0.22
12 Surprise Lake drain below B & L Landfill	1.5	08/23/83	150	0.1u	56	14	13	11	12	0.36	0.008	N/A
		10/21/83	100	0.1u	47	6.0	4.5	13	17	0.11	N/A	N/A
		02/14/84	120	0.1	55	20	12	29	19	0.17	0.059	0.15
14 HYLEBOS CREEK at 8th Avenue East	1.2	08/23/83	32	0.1	53	8.7	5	18	14	0.17	0.078	N/A
		10/21/83	42	0.1u	49	6.8	6.5	16	24	0.10	N/A	N/A
		02/14/84	15	0.1u	53	20	14	29	15	0.14	0.036	0.24
17 HYLEBOS CREEK mouth at Marine View Drive bridge	0.0	08/23/83	60	0.4	78	34	20	12	14	0.26	0.028	N/A
		02/14/84	100	0.7	130	43	31	30	18	0.26	0.034	0.14

u = not detected at detection limit shown
N/A = not analyzed

The fact that arsenic concentrations were to 60 and 100 mg/Kg in the two samples at Hylebos Creek mouth may reflect deposition in the estuarine portion of the creek. Abrupt increases in antimony, zinc, copper, and lead also occurred here. Grain-size analyses (Appendix II) showed sediment at the mouth to be two to three times higher in silt and clay than other parts of Hylebos Creek. Runoff from two log yards bordering the last several hundred feet of the creek are additional potential metals sources, as both yards have used ASARCO slag for ballast.

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Analysis of the initial sediment sample from upper Hylebos Creek indicated an elevated arsenic concentration of 21 mg/Kg. This may be further evidence of an arsenic source in the upper drainage; however, three subsequent sediment samples from this site had only 1.3 to 2.0 mg/Kg arsenic, failing to confirm the initial measurement.

Mercury concentrations measured in sediment in the last 1 1/2 miles of the creek were an order of magnitude higher than sediment in the upper drainage. The significance of this result is questionable given the poor results on duplicate sediment samples analyzed for QA purposes (Table 5) and the wide variation in mercury concentration in the two samples collected at Surprise Lake drain station 12. No potential sources of mercury are known in the drainage. The low-flow data showed less than detectable concentrations of mercury in all discharges sampled.

Fish Tissue - Metals concentrations measured in the two gill tissue samples from Hylebos Creek cutthroat trout are shown in Table 19. These data are compared to WDOE results from analysis of fish from other Western Washington rivers. Gills were analyzed in the Hylebos samples, rather than muscle or viscera, because this tissue best reflects ambient metal levels (Yake, 1977).

Table 19. WDOE data on metals in Hylebos Creek cutthroat trout and fish from other western Washington rivers (mg/Kg, dry weight).

Species	Date	Location	Tissue	Percent Solids	Arsenic	Zinc	Copper	Lead	Chromium	Cadmium	Mercury
Cutthroat trout (S. clarki)	8/24/83	Hylebos Creek	gill[a]	24.0	1.6	120	4.1	3.2	1.7	0.090	0.17
	"	" "	gill[b]	24.0	0.50	63	2.7	1.9	1.0	0.042	0.14
Rainbow trout (S. gairdneri)	8/25/83	Cedar River	gill	21.1	0.095	110	6.5	0.80	0.33	0.38	0.028
Mountain whitefish (P. williamsoni)	8/23/83	Skagit River	gill	22.0	0.14	100	5.9	2.4	2.4	0.23	0.27
	8/30/82	" "	whole	28.0	0.18	96	5.7	2.2	3.2	0.070	0.12
	9/09/82	Nisqually River	"	25.0	0.17	70	4.8	4.6	0.40	<0.080	0.30
	"	" "	gill	34.0	0.065	75	4.4	2.0	3.2	0.059	0.12
Northern squawfish (P. oregonensis)	9/30/82	Snohomish River	whole	26.0	0.070	11	5.0	1.5	5.4	0.15	0.19
	"	" "	gill	27.0	0.10	11	6.3	1.4	4.8	0.22	0.16
	9/29/80	Chehalis River	whole	23.0	N/A	68	7.3	5.5	1.1	0.30	0.46
Suckers (Catostomus spp.)	1979-1983	various rivers[c]	whole[d]	19.0-26.0	0.015-0.23	11-21	4.2-8.1	2.0-6.5	1.1-24	0.14-0.38	<0.10-.55
	" "	" "	gill[e]	16.1-29.0	0.007-0.37	47-99	4.3-9.3	1.5-3.0	0.31-25	0.087-0.25	0.054-.16

[a] sample #34562 (Table 3)
[b] sample #34563 (Table 3)
[c] Skagit, Snohomish, Green/Duwamish, Nisqually, and Cowlitz Rivers
[d] range of four samples
[e] range of five samples

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

Arsenic concentrations in the Hylebos gill tissues were 0.50 and 1.6 mg/Kg, dry weight. WDOE found a range in arsenic concentration of 0.007 to 0.37 mg/Kg in gill and whole fish samples from other rivers. For the samples from those fish with feeding habits similar to cutthroat trout (rainbow trout, whitefish, and squawfish), the range is 0.065 to 0.18 mg/Kg. Hylebos tissues concentrations of other metals included in these analyses are comparable with the other rivers.

Routine Monitoring at Hylebos Creek Mouth - The metals data from monthly monitoring at Hylebos Creek mouth between August 1983 and September 1984 are in Table 20. (Appendix IV has the conventional water quality data.) Metals concentrations remained generally within the ranges observed during the surveys done in August 1983 and February 1984. Concentrations of both total and dissolved metals decreased in the following order: arsenic > zinc, copper > lead > nickel, antimony > chromium > cadmium > mercury. Except for arsenic, the concentrations and relative abundance of metals in Hylebos Creek are similar to that in other western Washington rivers (USGS, 1981; WDOE monitoring data). Total arsenic concentrations are typically 2 ug/L or less in local rivers (Creceilus, 1975; Carpenter, 1978; Dexter, 1981), which is one order of magnitude lower than Hylebos Creek.

Table 20. Metals concentrations in Hylebos Creek at mouth; results from WDOE routine monitoring station 10G060 August 1983 - September 1984 (ug/L).

Date	Time	Flow (MGD)	Arsenic Total	Arsenic Diss.	Antimony Total	Antimony Diss.	Zinc Total	Zinc Diss.	Copper Total	Copper Diss.	Lead Total	Lead Diss.	Nickel Total	Nickel Diss.	Chromium Total	Chromium Diss.	Cadmium Total	Cadmium Diss.	Mercury Total
8/22/83	1135	5.0	1u	N/A	1u	N/A	16	N/A	23	N/A	11	N/A					0.3	N/A	0.06u
"	1230		1u	N/A	1u	N/A	5	N/A	12	N/A	11	N/A					0.1u	N/A	0.06u
8/23/83	1150	5.1	1u	N/A	1u	N/A	10	N/A	12	N/A	11	N/A					0.1	N/A	0.06u
"	1300		1u	N/A	6	N/A	14	N/A	18	N/A	8	N/A					0.1u	N/A	0.06u
8/24/83	1215	4.9	2	1u	3	1u	38	1u	10	8	11	1u					0.1	0.1u	0.06u
9/06/83	1250	6.1	24	N/A	1u	N/A							2	N/A	3	N/A	0.1	N/A	0.06u
10/26/83	0230	7.2	9	7	1u	1u	3	2	15	1u	9	1u	3	1	1	1u	0.1u		0.05u
11/08/83	0100	16.5	67	35	3	4	143	23	21	1	25	3	1u	1u	1u	1u	0.2	0.1u	0.11
12/19/83	2022	14.0	27	19	4	3	24	6	19	1	11	1u	1	1u	1u	1u	0.2u	0.2u	0.10
01/16/84	1945	8.9	32	6	1	1							1u	1u	2	2	0.1u		
02/14/84	2227	22.0	30		1	1u	25						18	1	5		0.1u	0.1u	
02/15/84	2110	26.5	42	N/A	1u	N/A	195	N/A					1u	N/A	5	N/A	0.1	N/A	
"	2120		36	4	3	2	19	9					1u	1u	1u	1u	0.1u		
"	2135		35	20	2	1	26	16					1	1u	1u	1u	0.1		
03/12/84	1900	44.0			1								13	3	4	1u	0.2u	0.2u	
04/10/84	1815	31.0											5	1	33	1	0.3	0.1	
05/03/84	1300	22.6	12	1u	1u	1u	7	1u	21	9	11		1u	1u	18	N/A	0.2	N/A	
06/29/84	1320	33.6	47	4	2	1	30	13	31	7	5	1u	1u	1u	1u	1u	0.1u	0.1u	
07/11/84	0910	8.1	28	4	1u	1u	1u	1u	24	1	8	1u	9	1u	1u	1u	0.1u	0.1u	
08/08/84	0820	7.2			1	1u	1	1u	6	5			122	35			0.2		0.05u
09/05/84	0810	6.3	8	1	1u	1u	44		32	2	8	1	1u	1u	1u	1u	0.1u		0.33
Number of observations			18	11	20	13	17	10	13	9	12	7	16	14	15	11	21	8	11
Maximum value			67	35	6	4	195	23	32	9	25	3	122	35	33	2	0.3	0.1	0.33
Minimum value			1u	1u	1u	1u	1u	1u	6	1u	5	1u	1u	1u	1u	1u	0.1u	0.1u	0.05u
Median			26	4	1	1u	19	4	19	2	11	1u	1	1u	1u	1u	0.1	0.1u	0.06u

u = not detected at detection limit shown
N/A = not analyzed

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

To assess the importance of Hylebos Creek as an arsenic source to Hylebos Waterway, the WDOE data on flow and arsenic concentrations available for 23 discharges to the waterway were tabulated (Appendix V) and the discharges ranked by arsenic load in Table 21. Based on a single measurement, the largest load, 3.9 pounds/day (net), was found for the Pennwalt final effluent. Data reported by Pennwalt in their consolidated permit show a net effluent load of 2.5 pounds/day. Of the remaining 23 discharges, four have median loads of up to a pound per day or more. These are, in order of decreasing load, Wasser/Winters log sort yard, Hylebos Creek, Dunlap log sort yard, and Murry Pacific log sort yards. All these yards have used ASARCO slag for ballast. The arsenic content in runoff from log sort yards on the Tacoma tideflats is discussed in a separate WDOE report (Norton, 1984).

Table 21. Arsenic loads in discharges to Hylebos Waterway calculated from WDOE data collected September 1979 - September 1984.

Discharge	Date(s)	Arsenic Load (pounds/day) Median	Range	Number of Observations
Pennwalt process effluent	6/2-3/81	3.9	--	1
Wasser/Winters log yard	11/4/83 - 5/3/84	3.8	1.5 - 10.4	5
HYLEBOS CREEK	8/17/81 - 9/5/84	2.2	ND - 13.0	15
Dunlap log yard	11/4/83; 6/29/84	1.7	1.7; 1.7	2
Murry Pacific log yard	11/4/83 - 5/3/84	1.2	0.25 - 3.1	5
Cascade Timber log yard	12/12/83; 6/29/84	0.61	0.73; 0.49	2
Louisiana Pacific log yard	" "	0.50	0.47; 0.53	2
Kaiser ditch	8/17/81 - 4/17/84	0.31	ND - 1.9	8
West drain opposite Lincoln Avenue	4/28/82	0.044	--	1
Morningside drain	8/17/81 - 11/8/83	0.024	0.008 - 1.3	4
East property line ditch at Pennwalt	6/2/81 - 5/17/84	0.023	0.005 - 0.097	3
Weyerhaeuser log yard	1/5/84; 6/29/84	0.019	0.006; 0.032	2
Sound Refining process effluent	6/30/81	0.010	--	1
Lincoln Avenue drain	4/28/82 - 5/30/84	0.009	0.009 - 0.011	3
East drain opposite Lincoln Avenue	4/28/82	0.005	--	1
East seep at Pennwalt	6/2/81; 4/18/84	0.0012	0.0004; 0.002	2
Drainage at 11th Street Bridge	4/28/82 - 5/30/84	0.0009	0.0007 - 0.010	3
Seep #3 at Occidental	4/18/84	0.0009	--	1
Drain #003 at Sound Refining	6/30/81	0.0003	--	1
Seep #1 at Occidental	4/18/84	0.00003	--	1
" #2 " "	"	0.000003	--	1
Occidental process effluent	9/25-26/79	--	ND (30u)	1
Drain #004 at Sound Refining	6/30/81	--	ND (16u)	1
West drain at Sound Refining	"	--	ND (16u)	1

ND = not detected
u = detection limit

Memo to Jim Krull
Completion Report on WQIS Project 2 for the Commencement Bay Nearshore/ Tideflats Remedial Investigation: Metals Concentrations in Water, Sediment, and Fish Tissue Samples from Hylebos Creek drainage, August 1983 - September 1984

The median loads measured for the Wasser/Winter yard and Hylebos Creek are 3.8 and 2.2 pounds/day, respectively. If only the Hylebos Creek data from the November 1983-May 1984 period in which the log yard data were gathered are considered, the median arsenic load from the creek is 4.4 pounds/day. Since most log yard runoff occurs during winter storms, it is likely that Hylebos Creek constitutes the larger of these two arsenic loads to the waterway during periods of light precipitation in winter and for most of the remaining parts of the year other than during storm events. Based on limited data, it appears the Pennwalt effluent may be the largest arsenic source to Hylebos Waterway during periods of reduced flow (less than about 10 MGD, See Appendix V) in Hylebos Creek.

SUMMARY

The major findings of these surveys are as follows:

1. Low metals concentrations existed in Hylebos Creek during low flow. Arsenic, antimony, cadmium, and mercury were near or below detection limits. Median zinc, copper, and lead concentrations were in the range of 4 to 19 ug/L. Metals concentrations in discharges to Hylebos Creek were also low, except for arsenic (129 ug/L) and cadmium (1.3 ug/L) in the ditch bordering U.S. Gypsum landfill and arsenic (158 ug/L) in Surprise Lake drain. Elevated arsenic in Surprise Lake drain was due to leachate discharged from the B & L landfill which had an arsenic concentration of 26,900 ug/L. Arsenic concentrations in Surprise Lake drain upstream of B & L were below detection limits (1 ug/L). Flow in these discharges was too low to influence metals concentrations within Hylebos Creek.

   Arsenic concentrations in Surprise Lake drain were potentially toxic to aquatic life. A 96-hour bioassay done on B & L leachate showed 43 percent mortality among juvenile coho salmon exposed to a 50 percent concentration of leachate. Exposure to a leachate concentration of 10 percent resulted in a non-toxic response. No long-term tests were done.

2. Metals concentrations in Hylebos Creek drainage during a survey done in wet-weather conditions were not substantially different than during low flow except that arsenic concentrations were higher in most parts of the drainage. A median arsenic concentration of 29 ug/L measured in upper Hylebos Creek suggests a source in the upper basin. Median arsenic concentrations in Hylebos Creek increased from 6 ug/L to 14 ug/L in passing U.S. Gypsum landfill, and from 14 ug/L to 45 ug/L in

passing Surprise lake drainage/B & L landfill. The arsenic loads measured in discharges to Hylebos Creek were higher than during the low-flow survey and accounted for the changes in concentrations observed in the creek except for an increased arsenic concentration in the vicinity of the U.S. Gypsum landfill, probably because only part of the discharge from this site could be sampled.

3. Substantial increases in arsenic concentrations in sediment were observed below both landfills. At U.S. Gypsum landfill, concentrations increased from 3.0 - 5.1 mg/Kg to 24 - 45 mg/Kg (dry weight). Sediment in Surprise Lake drainage above the B & L landfill had arsenic concentrations of 10 to 13 mg/Kg compared to 100 to 150 mg/Kg below the fill. High concentrations of arsenic, 60 and 100 mg/Kg, were also observed in sediment at the mouth of Hylebos Creek.

4. Gill tissue from two samples of Hylebos Creek cutthroat trout had arsenic concentrations of 0.50 and 1.6 mg/Kg (dry weight). These concentrations are one to two orders of magnitude above concentrations in gill and whole fish samples collected by WDOE from other western Washington rivers.

5. Monthly samples collected at the mouth of Hylebos Creek between August 1983 and September 1984 showed that, except for arsenic, metals concentrations and relative abundance of different metals were similar to other rivers in western Washington. Arsenic concentrations at the mouth of Hylebos Creek were typically an order of magnitude higher than in other local rivers. A median arsenic load of 2.2 pounds/day was calculated for the creek's discharge to Hylebos Waterway. Comparison with loads in other waterway discharges indicates Hylebos Creek and the Pennwalt process effluent are the major sources of arsenic to these waters except during storm events when runoff from log sort yards with ASARCO slag ballast may predominate.

AJ:cp

Attachments

REFERENCES

Alderdice, D.F. and J.R. Brett, 1957. Toxicity of sodium arsenite to young chum salmon. Prog. Rept. No. 108. Fish. Res. Bd. Canada.

Arp, R., 1984. EPA/WDOE Manchester laboratory, personal communication.

Carpenter, R., M.L. Peterson, and R.A. Janke, 1978. Sources sinks and cycling of arsenic in the Puget Sound region. in: Estuarine Interactions (M.L. Wiley, ed.) pp. 459-480.

Cloud, G., 1985. WDOE, personal communication.

Consoer, Townsend and Assoc., 1974. Hylebos Basin Drainage Plan, Part A, Engineering Study for the Hylebos Flood Control Zone District. Tacoma, Washington.

Crecelius, E.A., M.H. Bothner, and R. Carpenter, 1975. Geochemistries of arsenic, antimony, mercury, and elated elements in sediments of Puget Sound. Envir. Sci. Tech. 9(4): 325-333

Dames & Moore, 1982. Report of Phase I Investigation, Past Waste Management Practices at Two Disposal Sites, Pierce County, Washington. For U.S. Gypsum Company

Dames & Moore, 1983. Data supplied to R. Pierce, WDOE.

Dexter, R.N., et al., 1981. A Summary of Knowledge of Puget Sound Related to Chemical Contaminants. NOAA Tech. Memo. OMPA-13.

EPA, 1979 (revised 1983). Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020. Environmental Monitoring and Support Laboratory, Cincinnati, OH.

EPA, 1980. Water quality criteria documents; availability. Fed. Reg. 45(231): 79318-79379.

EPA, 1982. Test Methods for Evaluation of Solids Wastes: Physical/Chemical Methods. SW-846.

EPA/COE, 1981. Procedures for Handling and Chemical Analysis of Sediment and Water Samples. Tech. Rept. EPA/CE-81-1.

Hedges, J., 1984. Tacoma-Pierce County Health Department, personal communication.

Holland, G.E., et al., 1960. Toxic Effects of Organic and Inorganic Pollutants on Young Salmon and Trout. Wash. Dept. Fish., Res. Bull. No. 5.

Kjosness, D., 1983. 96-hour bioassay information, sample from B & L landfill, Tacoma. WDOE memorandum to D. Norton.

Kittle, L.J., 1984. WDOE, personal communication.

Norton, D. 1984 (in prep). Assessment of Log Sort Yards as Metals Sources to Commencement Bay Waterways, November 1983 - June 1984. WDOE. Memo. to J. Krull.

Pierce, R., 1985. WDOE, personal communication.

Phinney, L.A. and P. Bucknell, 1975. A Catalog of Washington Streams and Salmon Utilization (R.W. Williams, ed.). Wash. Dept. Fisheries.

Stinson, M., 1984a. Mercury contamination in samples shipped from the Southwest lab. WDOE memorandum to M. McCall.

Stinson, M., 1984b. EPA/WDOE Manchester laboratory, personal communication.

Tetra Tech, Inc., 1983. Final QA Program Plan for Commencement Bay Nearshore/ Tideflats Remedial Investigation. Bellevue, WA.

Thayer, D., 1983. Biologist, Puyallup Tribe of Indians, personal communication.

U.S. Geological Survey, 1981. Water Resources Data for Washington, Volume 1. Western Washington. USGS Water-Data Report WA-80-1.

WDOE, 1981. General Procedure for Static Basic Acute Fish Toxicity Test.

WDOE, 1983. Quality Assurance Program Plan for WDOE Water Quality Investigations Section's Projects No. 1 - No. 5 under Task 4 of the Commencement Bay Nearshore/ Tideflats Remedial Investigation.

WDOE, 1984. "DDT concentrations in Hylebos Creek cutthroat trout." Memo. from A. Johnson to J. Krull.

Yake, W.E., 1977. "Heavy metals in aquatic ecosystems with special reference to the fish of the Spokane River, Washington." M.S. Thesis, Wash. St. Univ.

APPENDIX I

Results of Organic Priority Pollutant/Hazardous Substances Analysis
on Leachate Sample from B & L Landfill
Collected by WDOE February 14, 1984

Appendix I. Compounds detected in leachate sample from B & L landfill collected by WDOE February 14, 1984.

Compound	Concentration (ug/L)	EPA Criteria (ug/L)[1]	NIOSH Data[2]
4-methylphenol	6,400	None	Oral rat LD_{50}: 242 mg/Kg
benzoic acid	600	None	Oral rat LD_{50}: 2530 mg/Kg
phenol	400	10,200 acute toxicity f.w. life 300 human organoleptic	Aq. Tox. Rating: TLm96: 100-10 ppm
toluene	38	17,500 acute toxicity f.w. life 14,300 human health	Aq. Tox. rating: TLm96: 100-10 ppm
2-methylphenol	28	None	Oral rat LD_{50}: 121 mg/Kg
2-hexanone	8.4m	None	None
4-methyl-2-pentanone	5.7m	None	Aq. Tox. Rating: TLm96: over 1000 ppm
ethylbenzene	1.7m	32,000 acute toxicity f.w. life 1,400 human health	Aq. Tox. Rating: TLm96: 100-10 ppm

[1] Fed. Reg., Vol. 45 no. 231, November 1980.

[2] Registry of Toxic Effects of Chemical Substances. 1982. Nat. Inst. Occup. Safety & Health.

m = detected, but concentration below quantification limit shown.

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. BOX 818, Alexandria, Virginia 22313 - 703/557-2490

DATA PREP/RELEASE BY: C.C / [illegible]

SAMPLE NO: J 3433
B & L Leachate
February 14, 1984

ORGANICS ANALYSIS DATA SHEET

LABORATORY: California Analytical Labs, Inc.
LAB SAMPLE NO: S4052

CASE NO: 2354/730J
QC REPORT NO: RED 730J-4
CONTRACT NO: 68-01-6763

DATE SAMPLE REC'D: 2/16/84
SAMPLE MATRIX: WATER
PERCENT MOISTURE:

COVER LETTER IS AN INTEGRAL PART OF THIS REPORT - PLEASE READ

SEMIVOLATILE COMPOUNDS

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/20/84
DATE ANALYZED: 3/13/84

PP#	CAS #		ug/L
21A	88-06-2	2,4,6-trichlorophenol	1.0 U
22A	59-50-7	p-chloro-m-cresol	1.0 U
24A	95-57-8	2-chlorophenol	1.0 U
31A	120-83-2	2,4-dichlorophenol	1.0 U
34A	105-67-9	2,4-dimethylphenol	1.0 U
57A	88-75-5	2-nitrophenol	1.0 U
59A	100-02-7	4-nitrophenol	1.0 U
59A	51-28-5	2,4-dinitrophenol	1.0 U
60A	534-52-1	4,6-dinitro-o-cresol	1.0 U
64A	87-86-5	pentachlorophenol	1.0 U
65A	108-95-2	phenol	(400)
CL1	65-85-0	benzoic acid	(600)
CL2	95-48-7	2-methylphenol	(28)
CL3	108-39-4	4-methylphenol	(6400)
CL4	95-95-4	2,4,5-trichlorophenol	1.0 U
1B	83-32-9	acenaphthene	0.1 U
5B	92-87-5	benzidine	1.0 U
8B	120-82-1	1,2,4-trichlorobenzene	1.0 U
9B	118-74-1	hexachlorobenzene	1.0 U
12B	67-72-1	hexachloroethane	1.0 U
18B	111-44-4	bis(2-chloroethyl)ether	1.0 U
20B	91-58-7	2-chloronaphthalene	1.0 U
25B	95-50-1	1,2-dichlorobenzene	1.0 U
26B	541-73-1	1,3-dichlorobenzene	1.0 U
27B	106-46-7	1,4-dichlorobenzene	1.0 U
28B	91-94-1	3,3'-dichlorobenzidine	1.0 U
35B	121-14-2	2,4-dinitrotoluene	1.0 U
36B	606-20-2	2,6-dinitrotoluene	1.0 U
37B	122-66-7	1,2-diphenylhydrazine	1.0 U
39B	206-44-0	fluoranthene	0.1 U
40B	7005-72-3	4-chlorophenyl phenyl ether	1.0 U
41B	101-55-3	4-bromophenyl phenyl ether	1.0 U
42B	39638-32-9	bis(2-chloroisopropyl) ether	1.0 U
43B	111-91-1	bis(2-chloroethoxy) methane	1.0 U
52B	87-68-3	hexachlorobutadiene	1.0 U
53B	77-47-4	hexachlorocyclopentadiene	1.0 U
54B	78-59-1	isophorone	1.0 U
55B	91-20-3	naphthalene	1.0 U
56B	98-95-3	nitrobenzene	1.0 U
62B	86-30-6	N-nitrosodiphenylamine	1.0 U
63B	621-64-7	N-nitrosodipropylamine	1.0 U
66B	117-81-7	bis(2-ethylhexyl)phthalate	1.0 U
67B	85-68-7	benzyl butyl phthalate	1.0 U
68B	84-74-2	di-n-butyl phthalate	1.0 U
69B	117-84-0	di-n-octyl phthalate	1.0 U
70B	84-66-2	diethyl phthalate	1.0 U
71B	131-11-3	dimethyl phthalate	1.0 U
72B	56-55-3	benzo(a)anthracene	0.1 U
73B	50-32-8	benzo(a)pyrene	0.1 U
74B	205-99-2	benzo(b)fluoranthene	0.1 U
75B	207-08-9	benzo(k)fluoranthene	0.1 U
76B	218-01-9	chrysene	0.1 U
77B	208-96-8	acenaphthylene	0.1 U
78B	120-12-7	anthracene	0.1 U
79B	191-24-2	benzo(ghi)perylene	0.1 U
80B	86-73-7	fluorene	0.1 U
81B	85-01-8	phenanthrene	0.1 U
82B	53-70-3	dibenzo(a,h)anthracene	0.1 U
83B	193-39-5	indeno(1,2,3-cd)pyrene	0.1 U
84B	129-00-0	pyrene	0.1 U
CL5	62-53-3	aniline	1.0 U
CL6	100-51-6	benzyl alcohol	1.0 U
CL7	106-47-8	4-chloroaniline	1.0 U
CL8	132-64-9	dibenzofuran	0.1 U
CL9	91-57-6	2-methylnaphthalene	1.0 U
CL10	88-74-4	2-nitroaniline	1.0 U
CL11	99-09-2	3-nitroaniline	1.0 U
CL12	100-01-6	4-nitroaniline	1.0 U

ABN COMPOUNDS - FS
FOR DATA REPORTING QUALIFIERS SEE COVER LETTER
DATA IS HELD FOR A MINIMUM OF 90 DAYS THEN SENT TO NEIC FOR EVIDENCE AUDITING

IRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
ox 818, Alexandria, Virginia 22313 - 703/557-2490

VTA PREP/RELEASE BY: _____ / _____

SAMPLE NO: J 3438
B & L Leachate
February 14, 1984

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME: California Analytical Labs, Inc.
LAB SAMPLE NO: 54052

CASE NO: 2354/730J
QC REPORT NO: RED 730J-4
CONTRACT NO: 68-01-6763

DATE SAMPLE REC'D: 02/16/84
SAMPLE MATRIX: WATER
PERCENT MOISTURE:

COVER LETTER IS AN INTEGRAL PART OF THIS REPORT - PLEASE READ

VOLATILES

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE ANALYZED: 2/22/84

PP#	CAS #		ug/L
2V	107-02-8	acrolein	10 U
3V	107-13-1	acrylonitrile	10 U
4V	71-43-2	benzene	1 U
6V	56-23-5	carbon tetrachloride	1 U
7V	108-90-7	chlorobenzene	1 U
10V	107-06-2	1,2-dichloroethane	1 U
11V	71-55-6	1,1,1-trichloroethane	1 U
13V	75-34-3	1,1-dichloroethane	1 U
14V	79-00-5	1,1,2-trichloroethane	1 U
15V	79-34-5	1,1,2,2-tetrachloroethane	1 U
18V	75-00-3	chloroethane	1 U
19V	110-75-8	2-chloroethylvinyl ether	10 U
23V	67-66-3	chloroform	1 U
29V	75-35-4	1,1-dichloroethene	1 U
30V	156-60-5	trans-1,2-dichloroethene	1 U
32V	78-87-5	1,2-dichloropropane	1 U
33V	10061-02-6	trans-1,3-dichloropropene	1 U
	10061-01-5	cis-1,3-dichloropropene	1 U
38V	100-41-4	ethylbenzene	1.7M
44V	75-09-2	methylene chloride	1 U
45V	74-87-3	chloromethane	1 U
46V	74-83-9	bromomethane	1 U
47V	75-25-2	bromoform	1 U
48V	75-27-4	bromodichloromethane	1 U
49V	75-69-4	fluorotrichloromethane	1 U
50V	75-71-8	dichlorodifluoromethane	1 U
51V	124-48-1	chlorodibromomethane	1 U
85V	127-18-4	tetrachloroethene	1 U
86V	108-88-3	toluene	(38)
87V	79-01-6	trichloroethene	1 U
88V	75-01-4	vinyl chloride	1 U
CL13	67-64-1	acetone	(370)
CL14	78-93-3	2-butanone	5 U
CL15	75-15-0	carbondisulfide	1 U
CL16	519-78-6	2-hexanone	8.4M
CL17	108-10-1	4-methyl-2-pentanone	5.7M
CL18	100-42-5	styrene	1 U
CL19	108-05-4	vinyl acetate	5 U

PESTICIDES

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/17/84
DATE ANALYZED: 03/12/84

PP#	CAS #		ug/L
89P	309-00-2	aldrin	0.05 U
90P	60-57-1	dieldrin	0.05 U
91P	57-74-9	chlordane	0.50 U
92P	50-29-3	4,4'-DDT	0.10 U
93P	72-55-9	4,4'-DDE	0.05 U
94P	72-54-8	4,4'-DDD	0.10 U
95P	115-29-7	a-endosulfan	0.05 U
96P	115-29-7	b-endosulfan	0.05 U
97P	1031-07-8	endosulfan sulfate	0.10 U
98P	72-20-8	endrin	0.05 U
99P	7421-93-4	endrin aldehyde	0.10 U
100P	76-44-8	heptachlor	0.05 U
101P	1024-57-3	heptachlor epoxide	0.05 U
102P	319-84-6	a-BHC	0.05 U
103P	319-85-7	b-BHC	0.05 U
104P	319-86-8	d-BHC	0.05 U
105P	58-89-9	g-BHC (lindane)	0.05 U
106P	53469-21-9	PCB-1242	0.50 U
107P	11097-69-1	PCB-1254	1.0 U
108P	11104-28-2	PCB-1221	1.0 U
109P	11141-16-5	PCB-1232	1.0 U
110P	12672-29-6	PCB-1248	1.0 U
111P	11096-82-5	PCB-1260	2.0 U
112P	12674-11-2	PCB-1016	0.50 U
113P	8001-35-2	toxaphene 10 U	~~2.0 U~~ jaw

DIOXINS

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/17/84
DATE ANALYZED: 3/13/84

PP#	CAS #		ug/L
1298	1746-01-6	2,3,7,8-tetrachloro-dibenzo-p-dioxin	0.03 U

DIOXINS-FS (89) 7/2/84

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. BOX 818, Alexandria, Virginia 22313 - 703/557-2490

DATA PREP/RELEASE BY: CC / [signature]

SAMPLE NO: J 3436

transport blank
February 14, 1984

ORGANICS ANALYSIS DATA SHEET

LABORATORY: California Analytical Labs, Inc.
EPA SAMPLE NO: 54050

CASE NO: 2354/730J
QC REPORT NO: REO 730J-4
CONTRACT NO: 68-01-6763

DATE SAMPLE REC'D: 2/16/84
SAMPLE MATRIX: WATER
PERCENT MOISTURE:

COVER LETTER IS AN INTEGRAL PART OF THIS REPORT - PLEASE READ

SEMIVOLATILE COMPOUNDS

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/20/84
DATE ANALYZED: 3/13/84

	CAS #		ug/L	PP#	CAS #		ug/L
	88-06-2	2,4,6-trichlorophenol	1.0 U	52B	87-68-3	hexachlorobutadiene	1.0 U
	59-50-7	p-chloro-m-cresol	1.0 U	53B	77-47-4	hexachlorocyclopentadiene	1.0 U
	95-57-8	2-chlorophenol	1.0 U	54B	78-59-1	isophorone	1.0 U
	120-83-2	2,4-dichlorophenol	1.0 U	55B	91-28-5	naphthalene	1.0 U
A	105-67-9	2,4-dimethylphenol	1.0 U	56B	98-95-3	nitrobenzene	1.0 U
	88-75-5	2-nitrophenol	1.0 U	57B	86-30-6	N-nitrosodiphenylamine	1.0 U
	100-02-7	4-nitrophenol	1.0 U	58B	621-64-7	N-nitrosodipropylamine	1.0 U
	51-28-5	2,4-dinitrophenol	1.0 U	59B	117-81-7	bis(2-ethylhexyl)phthalate	1.0 U
	534-52-1	4,6-dinitro-o-cresol	1.0 U	67B	85-68-7	benzyl butyl phthalate	1.0 U
	87-86-5	pentachlorophenol	1.0 U	68B	84-74-2	di-n-butyl phthalate	1.0 U
	108-95-2	phenol	1.0 U	69B	117-84-0	di-n-octyl phthalate	1.0 U
	65-85-0	benzoic acid	1.0 U	70B	84-66-2	diethyl phthalate	1.0 U
	95-48-7	2-methylphenol	1.0 U	71B	131-11-3	dimethyl phthalate	1.0 U
	108-39-4	4-methylphenol	1.0 U	72B	56-55-3	benzo(a)anthracene	0.1 U
	95-95-4	2,4,5-trichlorophenol	1.0 U	73B	50-32-8	benzo(a)pyrene	0.1 U
1B	83-32-9	acenaphthene	0.1 U	74B	205-99-2	benzo(b)fluoranthene	0.1 U
2B	92-87-5	benzidine	1.0 U	75B	207-08-9	benzo(k)fluoranthene	0.1 U
3B	120-82-1	1,2,4-trichlorobenzene	1.0 U	76B	218-01-9	chrysene	0.1 U
4B	118-74-1	hexachlorobenzene	1.0 U	77B	208-96-8	acenaphthylene	0.1 U
5B	67-72-1	hexachloroethane	1.0 U	78B	120-12-7	anthracene	0.1 U
6B	111-44-4	bis(2-chloroethyl)ether	1.0 U	79B	191-24-2	benzo(ghi)perylene	0.1 U
7B	91-58-7	2-chloronaphthalene	1.0 U	80B	86-73-7	fluorene	0.1 U
8B	95-50-1	1,2-dichlorobenzene	1.0 U	81B	85-01-8	phenanthrene	0.1 U
9B	541-73-1	1,3-dichlorobenzene	1.0 U	82B	53-70-3	dibenzo(a,h)anthracene	0.1 U
10B	106-46-7	1,4-dichlorobenzene	1.0 U	83B	193-39-5	indeno(1,2,3-cd)pyrene	0.1 U
11B	91-94-1	3,3'-dichlorobenzidine	1.0 U	84B	129-00-0	pyrene	0.1 U
12B	121-14-2	2,4-dinitrotoluene	1.0 U	CL5	62-53-3	aniline	1.0 U
13B	606-20-2	2,6-dinitrotoluene	1.0 U	CL6	100-51-6	benzyl alcohol	1.0 U
14B	122-66-7	1,2-diphenylhydrazine	1.0 U	CL7	106-47-8	4-chloroaniline	1.0 U
15B	206-44-0	fluoranthene	0.1 U	CL8	132-64-9	dibenzofuran	0.1 U
16B	7005-72-3	4-chlorophenyl phenyl ether	1.0 U	CL9	91-57-6	2-methylnaphthalene	1.0 U
17B	101-55-3	4-bromophenyl phenyl ether	1.0 U	CL10	88-74-4	2-nitroaniline	1.0 U
18B	39638-32-9	bis(2-chloroisopropyl) ether	1.0 U	CL11	99-09-2	3-nitroaniline	1.0 U
19B	111-91-1	bis(2-chloroethoxy) methane	1.0 U	CL12	100-01-6	4-nitroaniline	1.0 U

VOA COMPOUNDS - FS
CLP DATA REPORTING QUALIFIERS SEE COVER LETTER
DATA IS HELD FOR A MINIMUM OF 90 DAYS THEN SENT TO NEIC FOR EVIDENCE AUDITING

[signature] 9/2/84

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. Box 818, Alexandria, Virginia 22313 - 703/557-2490

DATA PREP/RELEASE BY: Lynn / [signature]

SAMPLE NO: J 3436 transport blank
February 14, 1984

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME: California Analytical Labs, Inc.
LAB SAMPLE NO: S4050

CASE NO: 2354/730J
QC REPORT NO: RED 730J-4
CONTRACT NO: 68-01-6763

DATE SAMPLE REC'D: 02/16/84
SAMPLE MATRIX: WATER
PERCENT MOISTURE:

COVER LETTER IS AN INTEGRAL PART OF THIS REPORT - PLEASE READ

VOLATILES

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE ANALYZED: 2/22/84

CAS #		ug/L
107-02-8	acrolein	10 U
107-13-1	acrylonitrile	10 U
71-43-2	benzene	1 U
56-23-5	carbon tetrachloride	1 U
108-90-7	chlorobenzene	1 U
107-06-2	1,2-dichloroethane	1 U
71-55-6	1,1,1-trichloroethane	1 U
75-34-3	1,1-dichloroethane	1 U
79-00-5	1,1,2-trichloroethane	1 U
79-34-5	1,1,2,2-tetrachloroethane	1 U
75-00-3	chloroethane	1 U
110-75-8	2-chloroethylvinyl ether	10 U
67-66-3	chloroform	1 U
75-35-4	1,1-dichloroethene	1 U
156-60-5	trans-1,2-dichloroethene	1 U
78-87-5	1,2-dichloropropane	1 U
10061-02-6	trans-1,3-dichloropropene	1 U
10061-01-5	cis-1,3-dichloropropene	1 U
100-41-4	ethylbenzene	1 U
75-09-2	methylene chloride	1 U
74-87-3	chloromethane	1 U
74-83-9	bromomethane	1 U
75-25-2	bromoform	1 U
75-27-4	bromodichloromethane	1 U
75-69-4	fluorotrichloromethane	1 U
75-71-8	dichlorodifluoromethane	1 U
124-48-1	chlorodibromomethane	1 U
127-18-4	tetrachloroethene	1 U
108-88-3	toluene	1 U
79-01-6	trichloroethene	1 U
75-01-4	vinyl chloride	1 U
67-64-1	acetone	5 U
78-93-3	2-butanone	5 U
75-15-0	carbondisulfide	1 U
519-78-6	2-hexanone	5 U
108-10-1	4-methyl-2-pentanone	5 U
100-42-5	styrene	1 U
108-05-4	vinyl acetate	5 U
95-47-6	total xylenes	1 U

PESTICIDES

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/17/84
DATE ANALYZED: 2/27/84

PP#	CAS #		ug/L
89P	309-00-2	aldrin	0.05 U
90P	60-57-1	dieldrin	0.05 U
91P	57-74-9	chlordane	0.50 U
92P	50-29-3	4,4'-DDT	0.10 U
93P	72-55-9	4,4'-DDE	0.05 U
94P	72-54-8	4,4'-DDD	0.10 U
95P	115-29-7	a-endosulfan	0.05 U
96P	115-29-7	b-endosulfan	0.05 U
97P	1031-07-8	endosulfan sulfate	0.10 U
98P	72-20-8	endrin	0.05 U
99P	7421-93-4	endrin aldehyde	0.10 U
100P	76-44-8	heptachlor	0.05 U
101P	1024-57-3	heptachlor epoxide	0.05 U
102P	319-84-6	a-BHC	0.05 U
103P	319-85-7	b-BHC	0.05 U
104P	319-86-8	d-BHC	0.05 U
105P	58-89-9	g-BHC (lindane)	0.05 U
106P	53469-21-9	PCB-1242	0.50 U
107P	11097-69-1	PCB-1254	1.0 U
108P	11104-28-2	PCB-1221	1.0 U
109P	11141-16-5	PCB-1232	1.0 U
110P	12672-29-6	PCB-1248	1.0 U
111P	11096-82-5	PCB-1260	2.0 U
112P	12674-11-2	PCB-1016	0.50 U
113P	8001-35-2	toxaphene	2.0 U

DIOXINS

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/17/84
DATE ANALYZED: 3/14/84

PP#	CAS #		ug/L
129B	1746-01-6	2,3,7,8-tetrachloro-dibenzo-p-dioxin	0.03 U

DIOXINS-FS [signature] 7/2/84

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. BOX 818, Alexandria, Virginia 22313 - 703/557-2490

DATA PREP/RELEASE BY: CC / [illegible]

SAMPLE NO: J 3437 field blank
February 14, 1984

ORGANICS ANALYSIS DATA SHEET

LABORATORY: California Analytical Labs, Inc.
LAB SAMPLE NO: S4051

CASE NO: 2354/730J
QC REPORT NO: RED 730J-4
CONTRACT NO: 68-01-6763

DATE SAMPLE REC'D: 2/16/84
SAMPLE MATRIX: WATER
PERCENT MOISTURE:

COVER LETTER IS AN INTEGRAL PART OF THIS REPORT - PLEASE READ

SEMIVOLATILE COMPOUNDS

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/20/84
DATE ANALYZED: 3/13/84

PP#	CAS #		ug/L	PP#	CAS #		ug/L
21A	88-06-2	2,4,6-trichlorophenol	1.0 U	52B	87-68-3	hexachlorobutadiene	1.0 U
22A	59-50-7	p-chloro-m-cresol	1.0 U	53B	77-47-4	hexachlorocyclopentadiene	1.0 U
24A	95-57-8	2-chlorophenol	1.0 U	54B	78-59-1	isophorone	1.0 U
31A	120-83-2	2,4-dichlorophenol	1.0 U	55B	91-20-3	naphthalene	1.0 U
34A	105-67-9	2,4-dimethylphenol	1.0 U	56B	98-95-3	nitrobenzene	1.0 U
47A	88-75-5	2-nitrophenol	1.0 U	62B	86-30-6	N-nitrosodiphenylamine	1.0 U
50A	100-02-7	4-nitrophenol	1.0 U	63B	621-64-7	N-nitrosodipropylamine	1.0 U
59A	51-28-5	2,4-dinitrophenol	1.0 U	66B	117-81-7	bis(2-ethylhexyl)phthalate	1.0 U
60A	534-52-1	4,6-dinitro-o-cresol	1.0 U	67B	85-68-7	benzyl butyl phthalate	1.0 U
34A	87-86-5	pentachlorophenol	1.0 U	68B	84-74-2	di-n-butyl phthalate	1.0 U
55A	108-95-2	phenol	1.0 U	69B	117-84-0	di-n-octyl phthalate	1.0 U
CL1	65-85-0	benzoic acid	1.0 U	70B	84-66-2	diethyl phthalate	1.0 U
CL2	95-48-7	2-methylphenol	1.0 U	71B	131-11-3	dimethyl phthalate	1.0 U
CL3	108-39-4	4-methylphenol	1.0 U	72B	56-55-3	benzo(a)anthracene	0.1 U
CL4	95-95-4	2,4,5-trichlorophenol	1.0 U	73B	50-32-8	benzo(a)pyrene	0.1 U
1B	83-32-9	acenaphthene	0.1 U	74B	205-99-2	benzo(b)fluoranthene	0.1 U
5B	92-87-5	benzidine	1.0 U	75B	207-08-9	benzo(k)fluoranthene	0.1 U
8B	120-82-1	1,2,4-trichlorobenzene	1.0 U	76B	218-01-9	chrysene	0.1 U
9B	118-74-1	hexachlorobenzene	1.0 U	77B	208-96-8	acenaphthylene	0.1 U
12B	67-72-1	hexachloroethane	1.0 U	78B	120-12-7	anthracene	0.1 U
18B	111-44-4	bis(2-chloroethyl)ether	1.0 U	79B	191-24-2	benzo(ghi)perylene	0.1 U
20B	91-58-7	2-chloronaphthalene	1.0 U	80B	86-73-7	fluorene	0.1 U
23B	95-50-1	1,2-dichlorobenzene	1.0 U	81B	85-01-8	phenanthrene	0.1 U
26B	541-73-1	1,3-dichlorobenzene	1.0 U	82B	53-70-3	dibenzo(a,h)anthracene	0.1 U
27B	106-46-7	1,4-dichlorobenzene	1.0 U	83B	193-39-5	indeno(1,2,3-cd)pyrene	0.1 U
28B	91-94-1	3,3'-dichlorobenzidine	1.0 U	84B	129-00-0	pyrene	0.1 U
35B	121-14-2	2,4-dinitrotoluene	1.0 U	CL5	62-53-3	aniline	1.0 U
36B	606-20-2	2,6-dinitrotoluene	1.0 U	CL6	100-51-6	benzyl alcohol	1.0 U
37B	122-66-7	1,2-diphenylhydrazine	1.0 U	CL7	106-47-8	4-chloroaniline	1.0 U
39B	206-44-0	fluoranthene	0.1 U	CL8	132-64-9	dibenzofuran	0.1 U
40B	7005-72-3	4-chlorophenyl phenyl ether	1.0 U	CL9	91-57-6	2-methylnaphthalene	1.0 U
41B	101-55-3	4-bromophenyl phenyl ether	1.0 U	CL10	88-74-4	2-nitroaniline	1.0 U
42B	39638-32-9	bis(2-chloroisopropyl) ether	1.0 U	CL11	99-09-2	3-nitroaniline	1.0 U
43B	111-91-1	bis(2-chloroethoxy) methane	1.0 U	CL12	100-01-6	4-nitroaniline	1.0 U

ABN COMPOUNDS - FS
FOR DATA REPORTING QUALIFIERS SEE COVER LETTER
DATA IS HELD FOR A MINIMUM OF 90 DAYS THEN SENT TO NEIC FOR EVIDENCE AUDITING

3/2/84

U.S. ENVIRONMENTAL PROTECTION AGENCY - CLP Sample Management Office
P.O. Box 818, Alexandria, Virginia 22313 - 703/557-2490

DATA PREP/RELEASE BY: JW / 4/23/84

SAMPLE NO: J 3437 field blank
February 14, 1984

ORGANICS ANALYSIS DATA SHEET

LABORATORY NAME: California Analytical Labs, Inc.
LAB SAMPLE NO: 54051

CASE NO: 2354/730J
QC REPORT NO: REO 730J-4
CONTRACT NO: 68-01-6763

DATE SAMPLE REC'D: 02/16/84
SAMPLE MATRIX: WATER
PERCENT MOISTURE:

COVER LETTER IS AN INTEGRAL PART OF THIS REPORT - PLEASE READ

VOLATILES

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE ANALYZED: 2/22/84

PP#	CAS #		ug/L
2V	107-02-8	acrolein	10 U
3V	107-13-1	acrylonitrile	10 U
4V	71-43-2	benzene	1 U
6V	56-23-5	carbon tetrachloride	1 U
7V	108-90-7	chlorobenzene	1 U
10V	107-06-2	1,2-dichloroethane	1 U
11V	71-55-6	1,1,1-trichloroethane	1 U
13V	75-34-3	1,1-dichloroethane	1 U
14V	79-00-5	1,1,2-trichloroethane	1 U
15V	79-34-5	1;1,2,2-tetrachloroethane	1 U
16V	75-00-3	chloroethane	1 U
19V	110-75-8	2-chloroethylvinyl ether	10 U
23V	67-66-3	chloroform	1 U
29V	75-35-4	1,1-dichloroethene	1 U
30V	156-60-5	trans-1,2-dichloroethene	1 U
32V	78-87-5	1,2-dichloropropane	1 U
33V	10061-02-6	trans-1,3-dichloropropene	1 U
	10061-01-5	cis-1,3-dichloropropene	1 U
38V	100-41-4	ethylbenzene	1 U
44V	75-09-2	methylene chloride	1 U
45V	74-87-3	chloromethane	1 U
46V	74-83-9	bromomethane	1 U
47V	75-25-2	bromoform	1 U
48V	75-27-4	bromodichloromethane	1 U
49V	75-69-4	fluorotrichloromethane	1 U
50V	75-71-8	dichlorodifluoromethane	1 U
51V	124-48-1	chlorodibromomethane	1 U
85V	127-18-4	tetrachloroethene	1 U
86V	108-88-3	toluene	1 U
87V	79-01-6	trichloroethene	1 U
88V	75-01-4	vinyl chloride	1 U
CL13	67-64-1	acetone	5 U
CL14	78-93-3	2-butanone	5 U
CL15	75-15-0	carbondisulfide	1 U
CL16	519-78-6	2-hexanone	5 U
CL17	108-10-1	4-methyl-2-pentanone	5 U
CL18	100-42-5	styrene	1 U
CL19	108-05-4	vinyl acetate	5 U
CL20	95-47-6	total xylenes	1 U

PESTICIDES

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/17/84
DATE ANALYZED: 2/27/84

PP#	CAS #		ug/L
89P	309-00-2	aldrin	0.05 U
90P	60-57-1	dieldrin	0.05 U
91P	57-74-9	chlordane	0.50 U
92P	50-29-3	4,4'-DDT	0.10 U
93P	72-55-9	4,4'-DDE	0.05 U
94P	72-54-8	4,4'-DDD	0.10 U
95P	115-29-7	a-endosulfan	0.05 U
96P	115-29-7	b-endosulfan	0.05 U
97P	1031-07-8	endosulfan sulfate	0.10 U
98P	72-20-8	endrin	0.05 U
99P	7421-93-4	endrin aldehyde	0.10 U
100P	76-44-8	heptachlor	0.05 U
101P	1024-57-3	heptachlor epoxide	0.05 U
102P	319-84-6	a-BHC	0.05 U
103P	319-85-7	b-BHC	0.05 U
104P	319-86-8	d-BHC	0.05 U
105P	58-89-9	g-BHC (lindane)	0.05 U
106P	53469-21-9	PCB-1242	0.50 U
107P	11097-69-1	PCB-1254	1.0 U
108P	11104-28-2	PCB-1221	1.0 U
109P	11141-16-5	PCB-1232	1.0 U
110P	12672-29-6	PCB-1248	1.0 U
111P	11096-82-5	PCB-1260	2.0 U
112P	12674-11-2	PCB-1016	0.50 U
113P	8001-35-2	toxaphene	2.0 U

DIOXINS

CONCENTRATION: (LOW) MEDIUM HIGH (circle one)
DATE EXTRACTED/PREPARED: 2/17/84
DATE ANALYZED: 3/14/84

PP#	CAS #		ug/L
129B	1746-01-6	2,3,7,8-tetrachloro-dibenzo-p dioxin	0.03 U

DIOXINS-FS (JS) 7/2/84

APPENDIX II

Conventional Parameters on Hylebos Creek Sediment Samples
Collected by WDOE February 14, 1984

Appendix II. Physical properties and organic carbon content of Hylebos drainage sediment samples collected by WDOE February 14, 1984.

Station Number and Location	Solids (percent)	Gravel (percent)	Sand (percent)	Silt (percent)	Clay (percent)	Total Organic Carbon (percent)
1 Upper Hylebos Creek at 5th Avenue	73	0	97.60	1.68	0.72	0.31
4 Hylebos Creek above U.S. Gypsum	76	7.36	91.50	0.66	0.48	0.19
7 Hylebos Creek below U.S. Gpysum	75	8.05	89.71	0.84	1.40	1.29
9 Surprise Lake drain above B & L landfill	68	0.67	80.71	14.14	4.49	0.59
12 Surprise Lake drain at mouth	58	0.02	77.39	18.63	3.96	1.31
14 Hylebos Creek at 8th Avenue East	57	4.53	72.56	17.97	4.93	1.27
17 Hylebos Creek mouth at Marine View Drive bridge	51	1.33	49.90	34.74	14.03	1.46

APPENDIX III

Metals Field Blanks for WDOE Hylebos Creek Surveys
August 1983 - September 1984

Appendix III. Results of metals analysis on field blanks for WDOE surveys in Hylebos Creek August 1983 - September 1984 (ug/L).

Field Blank Number	Date of Survey	Arsenic	Antimony	Zinc	Copper	Lead	Nickel	Chromium	Cadmium	Mercury
330083	8/22-24/83	1u	1u	1u	1u	1u	11*	4*	0.1u	0.06
330084	"	1u	1u	1u	6	1u	1*	8*	0.1u	0.06u
330085	"	1u	1u	1u	1	1u	5*	3*	0.1u	0.06u
--	09/06/83	--	--	--	--	--	--	--	--	--
--	10/26/83	1	1u	1u	1u	1u	1u	1u	0.1u	0.05u
--	11/08/83	--	--	--	--	--	--	--	--	--
--	12/19/83	1u	1u	1u	1u	1u	1u	1	0.2u	0.05
140161	01/16/84	1u	1	25*	69*	8*	1u	1	0.1u	0.109*
140595	02/14/84	1	1u	2	18*	7*	1	4	0.1u	0.90*
140686	02/15/84	1u	1u	1	16*	9*	1u	1u	0.1u	N/A*
140687	"	1u	1u	3	21*	15*	1u	1u	0.1u	0.96*
140686 (filtrate)	"	1u	1u	3	21*	15*	1u	1u	0.1u	N/A
141012	03/12/84	19*	1	6*	27*	9*	1u	1u	0.2u	0.11*
141-13 (filtrate)	"	15*	2	9*	15*	8*	1u	1u	0.2u	N/A
141485	04/10/84	24*	3*	12*	10*	24*	1u	1u	0.1u	N/A*
141985	05/03/84	1u	1u	6	4	4	1u	N/A	0.2	N/A*
141986	"	1u	1u	1u	1u	1u	1u	N/A	0.1u	N/A*
141987	"	1u	1u	1u	1u	1u	1u	N/A	0.1u	N/A*
141937 (filtrate)	"	1u	1u	1u	1u	1u	1u	1u	0.1u	N/A
141938 "	"	1u	1u	1u	1u	1u	1u	1u	0.1u	N/A
142801	06/29/84	1u	1u	2	1	8	1u	1u	0.1u	1.0*
142802	"	1u	1u	1u	1u	1u	1u	1u	0.1u	0.30*
142803	"	1u	1u	1u	1u	1u	1u	1u	0.1u	0.35*
--	07/11/84	--	--	--	--	--	--	--	--	--
143476	08/08/84	3*	1u	1u	1u	3*	1u	6*	0.1	0.05u
--	09/05/84	--	--	--	--	--	--	--	--	--

* = data deleted from report due to elevated field blank
u = not detected at detection limit shown
N/A = not analyzed

APPENDIX IV

WDOE Routine Monitoring Data on Hylebos Creek Mouth
August 1983 - September 1984

STORET MINOR BASIN: PUGET SOUND STORET SUB BASIN: PUYALLUP-WHITE

LATITUDE: 47 16 33.0 ELEVATION (FEET): 5 WATER CLASS: A
LONGITUDE: 122 31 21.0 COUNTY: PIERCE

AGENCY: 21WA0000 STATE: WASHINGTON STA TYPE: OCN

TERMINAL STREAM	1ST LEV MILES	2ND LEV MILES	3RD LEV MILES	4TH LEV MILES	5TH LEV MILES	6TH LEV MILES
1311159	002.30					

DATE FROM TO	TIME	00060 STREAM FLOW CFS-AVG	00010 WATER TEMP DEG-C	00300 DISSOLVED OXYGEN mg/l	00301 DO PERCENT SATURATN	00400 pH STANDARD UNITS	00095 CONDUCTVY @ 25 C MICROMHOS	00530 SOLIDS SUSPENDED mg/l	00070 TURBIDITY TURBMETER NTU	00900 HARDNESS TOT CaCO3 mg/l	31616 FECAL COLIFORM /100ml MF
83/08/22	1135	7.7	14.8	9.7	95.7	7.5	1540	22	12.0	210.0	370
	1230										
83/08/23	1150	7.9	14.1	9.0	87.5	7.5	1560	22	13.0	210.0	2200
	1300										
83/08/24	1215	7.6	14.3	9.7	94.7	7.4	1470	25	15.0	173.0	15008
83/09/06	1250		13.0	9.2	87.1	7.4	903		13.0	130.0	320
83/10/26	0230	11.1	9.3	9.3	82.9	7.4	1440	12	10.0		45
83/11/08	0100		9.2	8.4	72.9	7.2	493	28		110.0	1408
83/12/19	2022	22.0	4.2	10.6	81.2	6.9	800	30	23.0	150.0	
84/01/16	1945	13.7	3.7	10.9	82.4	6.7	800	24	26.0	150.0	
84/02/14	2227	34.0	7.6			7.1	406	28	94.0	100.0	1100J
84/03/12	1900	68.0	10.1	9.7	85.8	7.0	238	83	96.0	72.0	
84/04/10	1815	48.0	9.9	10.0	88.1	7.0	318	99	86.0	84.0	1400
84/05/03	1300	35.0	10.9	9.2	83.0	7.1	318	31	28.0	96.0	
84/06/29	1320	52.0		7.7		6.9	310	54	36.0	84.0	
84/07/11	0910	12.5	12.8			7.4	1160	16	14.0	180.0	380
84/08/08	0820	11.1	14.2	8.1	78.9	7.4	1630	26	18.0	220.0	240
84/09/05	0810	9.7	13.2	8.6	82.0	7.6	1370	23	16.0	210.0	330
NUMBER OF SAMPLES		15	15	14	13	17	17	16	15	16	11
MAXIMUM VALUE		68.00	14.80	10.90	95.70	7.60	1630.00	99.00	96.00	220.00	2200.00
MINIMUM VALUE		7.60	3.70	7.70	72.90	6.70	238.00	12.00	10.00	72.00	45.00
MEDIAN		12.50	10.90	9.35	83.00	7.40	903.00	27.00	18.00	150.00	370.00

DATE FROM TO	TIME	00620 NITRATE T NO3-N mg/l	00615 NITRITE T NO2-N mg/l	00610 AMMONIA T NH3-N mg/l	00619 UN-IONZD AMMONIA mg/l	00617 UN-IONZD AMMONIA PERCENT	00671 DIS-ORTHO PHOSPHRUS mg/l P	00665 TOTAL PHOSPHRUS mg/l P
83/08/22	1135	0.61	0.02	0.20	0.002	0.846		0.16
	1230							
83/08/23	1150	0.62	0.02	0.25	0.002	0.802	0.17	0.17
	1300							
83/08/24	1215	0.69	0.02	0.24	0.002	0.648		0.18
83/09/06	1250	0.59	0.01	0.34	0.002	0.587		0.31
83/10/26	0230	0.64	0.01K	0.32	0.001	0.441		0.14
83/11/08	0100	2.50	0.03	0.26	0.001	0.277	0.19	0.21
83/12/19	2022	0.88	0.01K	0.59	0.001	0.093		0.13
84/01/16	1945	0.85		0.61	0.000	0.045	0.15	0.19
84/02/14	2227	1.20	0.01K	0.30	0.001	0.194		0.04
84/03/12	1900	0.66	0.01	0.20	0.000	0.187		0.05
84/04/10	1815	0.53	0.01K	0.24	0.000	0.185		0.08
84/05/03	1300	0.66	0.01K	0.64	0.001	0.251		0.19
84/06/29	1320	0.46	0.01K	0.47				0.23
84/07/11	0910	0.66	0.01K	0.50	0.003	0.578	0.24	0.28
84/08/08	0820	0.62	0.01	0.42	0.003	0.643	0.25	0.27
84/09/05	0810	0.75	0.01	0.30	0.003	0.942	0.18	0.18
NUMBER OF SAMPLES		16	15	16	15	13	8	16
MAXIMUM VALUE		2.50	0.03	0.64	0.003	0.942	0.25	0.31
MINIMUM VALUE		0.46	0.01	0.20	0.000	0.056	0.15	0.04
MEDIAN		0.66	0.01	0.31	0.002	0.441	0.19	0.18

APPENDIX V

Summary of WDOE Data
on Arsenic Discharges to Hylebos Waterway
1979-1984

Appendix V. Summary of WDOE data on arsenic in discharges to Hylebos Waterway, 1979 - 1984.

Discharge	Data Source	Date	Flow (MGD)	Arsenic Conc. (ug/L)	Arsenic Load (lbs/day)
Sound Refining west drain	a	06/30/81	0.071	16u	--
" " drain #004	"	"	0.0039	16u	--
" " process effluent	"	"	0.053	22	0.010
" " drain #003	"	"	0.001	37	0.0003
Cascade Timber log yard #1	d	12/12/83	0.012†	7,280	0.73
" " " " "	"	06/29/84	0.030†	1,970	0.49
West drain opposite Lincoln Avenue	b	04/28/82	0.060	89	0.044
East drain " " "	"	"	0.050	12	0.005
Morningside drain	"	08/17/81	0.13	7	0.008
" "	"	03/29/82	0.78	20	0.13
" "	c	09/06/83	0.49	2	0.008
" "	"	11/08/83	0.71	6	0.04
Manke lumber	"	05/30/83	--	6	--
Wasser/Winters log yard	d	11/04/83	0.07	7,100	4.2
" " "	"	12/29/83	0.32	1,400	3.8
" " "	"	03/12/84	0.15	8,300	10.4
" " "	"	04/10/84	0.095	3,000	2.4
" " "	"	05/03/84	0.015	12,000	1.5
Louisiana Pacific log yard	"	12/12/83	0.032†	1,980	0.53
" " " "	"	06/29/84	0.066	850	0.47
Hylebos Creek	b	08/17/81	4.1	5u	--
" "	"	03/29/82	32	36	9.6
" "	e	08/22-24/83	5.0	1u	--
" "	"	09/06/83	6.1	24	1.22
" "	"	10/26/83	7.2	9	0.54
" "	"	11/08/83	16	67	8.9
" "	"	12/19/83	14	27	3.2
" "	"	01/16/84	8.8	32	2.3
" "	"	02/14/84	22	30	5.5
" "	"	02/15/84	26	36	7.8
" "	"	05/03/84	22	12	2.2
" "	"	06/29/84	34	47	13
" "	"	07/11/84	8.1	28	1.2
" "	"	08/08/84	7.2	12	0.72
" "	"	09/05/84	6.3	8	0.42
Weyerhaeuser log yard	d	01/05/84	0.024	32	0.006
" " "	"	06/29/84	0.086	44	0.032

Appendix V. Continued.

Discharge	Data Source	Date	Flow (MGD)	Arsenic Conc. (ug/L)	Arsenic Load (lbs/day)
Kaiser ditch	b	08/17/81	2.8	5u	--
" "	"	03/29/82	1.8	88	1.3
" "	c	09/06/83	2.9	18	0.44
" "	"	09/19/83	0.23	27	0.052
" "	"	10/25/83	2.3	9	0.17
" "	"	11/08/83	1.3	44	0.48
" "	"	02/14/84	1.8	8	0.12
" "	"	04/17/84	1.9	120	1.9
Dunlap log yard	d	11/04/83	0.053†	3,800	1.7
" " "	"	06/29/84	0.078†	2,680	1.7
Pennwalt east property line ditch	a	06/02/81	0.0014	470	0.005
" " " " "	c	04/18/84	0.023	505	0.097
" " " " "	"	05/17/84	0.005	560	0.023
" " seep	a	06/02/81	0.0014	36	0.0004
" " "	c	04/18/84	0.0006	305	0.002
" process effluent	a	06/2-3/81	12.4	60	6.2 (total) 3.9(net)
Murry Pacific log yard #1	d	11/04/83	0.13	1,100	1.2
" " " " "	"	12/29/83	0.73	500	3.1
" " " " "	"	03/12/84	0.057	2,700	1.3
" " " " "	"	04/10/84	0.042	3,400	1.2
" " " " "	"	05/03/84	0.023	1,300	0.25
Lincoln Avenue drain	b	04/28/82	0.029	37	0.009
" " "	c	05/17/84	0.052	25	0.011
" " "	"	05/30/84	0.052	20	0.009
Drainage at 11th Street Bridge	b	04/28/82	0.040	31	0.010
" " " " "	c	05/17/84	0.026	4	0.0009
" " " " "	"	05/30/84	0.016	5	0.0007
Occidental seep #3	"	04/18/84	0.011	10	0.0009
" " #2	"	"	0.0002	2	0.000003
" process effluent	a	09/25-26/79	15.5	30u	--
" seep #1	c	04/18/84	0.0007	5	0.00003

Data sources: a - WDOE Class II surveys
b - WDOE (1984) A Summary of Priority Pollutant Data for Point Sources and Sediment in Inner Commencement Bay.
c - WDOE routine monitoring for Commencement Bay nearshore/tideflats investigation
d - Norton, D. (1985 in prep.) Assessment of Log Sort Yards as Metals Sources to Commencement Bay Waterways
e - Present survey.

u = not detected at detection limit shown
† = estimated